THE

AMERICAN NATURALIST

VOL. XXXIV. *August, 1900.* NO. 404.

ON THE NESTING HABITS OF THE BROOK LAMPREY (LAMPETRA WILDERI).

ROBERT T. YOUNG AND LEON J. COLE.

THE following notes on the nesting habits of the brook lamprey are not intended to cover completely this subject, but merely to amplify in a few details the observations of Gage [1] and Dean and Sumner.[2]

While at Ann Arbor, Mich., in the spring of 1899, we had the opportunity of observing several hundred brook lampreys nest building and spawning. They were in two small streams, about four miles west of Ann Arbor. The smaller was a tributary of the larger, and the latter emptied into the Huron River, a few miles from where my observations were made. From the mouth of this stream to Lake Erie the distance was about forty miles. We shall designate the smaller stream as A and the larger as B. Both streams flowed through meadow land. At points they were bordered by alders and willows.

[1] Gage, Simon Henry. Lake and Brook Lampreys of New York, *The Wilder Quarter Century Book*, 1893.

[2] Dean, Bashford, and Sumner, Francis B. Notes on the Spawning Habits of the Brook Lamprey (Petromyzon wilderi), *Trans. New York Acad. of Sci.*, vol. xvi. Dec. 9, 1897.

The stream bottom was mainly gravelly, but in many places sandy. The average width of stream B was ten feet, and of stream A three and one-half feet. Both had a moderately swift current.

Our observations were rather brief, covering only a portion of five days, from April 15 to April 20. Previous to April 15 there had been a succession of several warm days. On the 15th there was a decided fall of temperature. On the 17th another warm spell set in. On the 20th the temperature of the water at 4 P.M. was 63° F.

Gage is of the opinion that the males precede the females at spawning time and commence nest building before the arrival of the latter. This opinion is supported by the results obtained from a weir in the inlet of Cayuga Lake, N.Y., in the spring of 1898, which are recorded by Surface,[1] and also by our own observations. Following is a record of the number and sex of the fish taken by us during the period of observation.

April.	Time of Observation.	♂	♀	♀ Spawned.
15	3-5 P.M.	1	—	—
17	3-5 P.M.	8 or 10[2]	—	—
18	4-6.30 P.M.	44	11[3]	—
19	5.30 A.M. to 6.30 P.M.	98	18	9
20	3-4.30 P.M.	52	14	4

The activity of the lampreys and their manner of nest building are shown by the following results, which are the average of sixteen nests observed.

Time of Observation.	No. of Stones Moved.			
	Up Stream.	Down Stream.	Lateral.	No. of Fish.
4½ minutes	4	2	1	2-3

[1] Surface, H. A., M.S. The Lampreys of Central New York, *Bulletin for National Fishery Congress, United States Fish Commission* (1897), pp. 145-371.

[2] Stream A only. [3] Probably all gravid.

We do not think the lampreys have any definite method in the construction of their nests. When they seize a stone they usually endeavor to carry it straight ahead, without other instinct apparently than to remove it from the nest, no matter in what direction they may be heading. Often, however, they allow themselves to be carried down stream by the current, together with the stones which they have seized. A lamprey has been seen to carry a stone up stream a short distance and then allow itself to drift back again with it. In a few cases they have been observed to carry stones into the nest from without. They cling very persistently to whatever object they may have attached themselves, on one occasion a lamprey permitting itself to be lifted from the water attached to the boot of one of the writers. Contrary to the observation of Gage and Dean and Sumner, we have noted two lampreys move a stone conjointly. The largest stone moved (only an inch, however) by a single lamprey weighed thirty-three grams. In moving stones the lamprey arches its back and employs powerful brush-like movements of the tail against the stream bed, as in spawning. As noted by Dean and Sumner, one lamprey will frequently seize another and pull it away from its place of attachment. It is very interesting to watch them do this. One seizes another by the head and shakes it as a dog would a rat. In so doing they are usually carried out of the nest by the current, holding to each other for a short distance, when they separate and return to the nest.

The size of nests and depth of stream over them is expressed by the following data, which are the average for twenty-six nests.

Diameter ∥ to Current.	Diameter ⊥ to Current.	Depth of Stream.
7½ inches	7⅛ inches	15 inches[1]

There is considerable variation both in the form and situation of the nests. The longer diameter may be either parallel or perpendicular to the current. They may be situated in any

[1] Average for twenty-five nests.

depth of water from six to twenty-four inches, near the bank or in the middle of the stream, under an overhanging bank or log, or in open water. The number of fish in a nest varies from one to thirty or forty (usually from three to twenty-five).

On the morning of the 19th the number of lampreys observed was much smaller than on the preceding afternoon. While there were no fish present in stream A on that morning, there had been quite a number there on the afternoon of the 18th. About noon of the 19th they became numerous again. We were on the spawning grounds till sunset on the 18th, and from sunrise on the 19th, and no marked migration of fish was observed at any time. For about two hours, however, before noon of the 19th we were exploring another stream, and there may have been a return of the fish to their spawning grounds at that time. Why the fish were less numerous on the morning of the 19th, or what became of them during the preceding night, it is difficult to conjecture. We have to thank Professor Jacob E. Reighard of Ann Arbor for numerous valuable suggestions and assistance in conducting our observations.

Through the kindness of the editor of the *American Naturalist* the following note from Professor Gage has been forwarded to the writers, and they take pleasure in appending it herewith :

As pointed out by Jordan and others who have made a special study of the American brook lamprey (*L. wilderi*), none have ever been found parasitic upon fishes, and none have ever been found in the waters of brooks except during the spawning season. To explain the apparent anomalies in the life history of the brook lamprey, Gage (*Proc. Amer. Assoc. Adv. Sci.* [1898], p. 372, and [1899] p. 256) carried on observations in laboratory aquaria for four years and made field observations upon the same subject during the entire year. It was found that the brook lamprey : (1) never goes to the larger waters of the lake, but remains constantly in the brooks ; (2) it attains its full size during the larval state; (3) it is never parasitic, although a special œsophagus is developed as in parasitic forms (sea and lake lamprey), and the lingual and buccal teeth are fairly well developed ; (4) during the transformation period the animal remains under the sand like a larva (from September till April), during which time the eggs and zoösperms ripen ; (5) when the spawning season arrives (April–May) they emerge from the sand, build their nests, spawn, and disappear.

ON VARIATION OF THE ROSTRUM IN PALÆMONETES VULGARIS HERBST.

GEORG DUNCKER.

LAST summer, at the Cold Spring Harbor Biological Laboratory of the Brooklyn Institute, I investigated the number of rostral spines in 1050 shrimps, in order to test the relation between the average value of a varying character and its variability.

As is well known, Verschaeffelt ('94) first assumed the ratio between the probable deviation of a character and its median to be an absolute measure of its variability. Such ratios as probable deviation or median average deviation, or root of average square deviation to mean have been called "coefficients of variation" and have been frequently used, not only in merely arithmetical processes, but also in dealing with morphological questions; for instance, in applying them, Brewster ('97) and Field ('98) meant to show the variability of systematically important characters to be higher than that of other ones. Both Davenport (see Brewster ['97]) and Pearson ('97) believe the higher variability of homologous characters to be connected with the higher average value. Dr. Davenport, to whom I am much indebted for his kind interest and for numerous suggestions during my stay at Cold Spring Harbor, assumes the relation between the index of variability of a character and its average value to be similar to that between the errors of measurement and the length of a course measured by the chain used in surveying.

Now, in my opinion ('99), there is no relation whatever between the average and the variability of a character. While the average value is determined by such conditions as equally affect all the individuals of a form unit, external conditions (environment, climate, food, quality of soil or water), as well as constitutional conditions (specific nature, sex, stage

of development), the variability depends upon numerous minute positively and negatively acting causes, a part of which only affects, in each case, the simple individuals of form unit in different combinations. Then the relative frequency of the individual variants in a form unit corresponds to the possibility of these combinations. Therefore, the causes of variation are to be thought of as essentially different from the conditions determining the average value of a character in the total form unit. On the other hand, I assume a relation between the morphological and physiological peculiarity of the different characters and the causes of their individual variation, so that the single characters are only able to react on a part of the sum total of the latter ; therefore, in allied species homologous characters ought to show similar indices of variability, but not necessarily equal average values.

In 1892 Weldon investigated the numbers of dorsal and ventral spines of the rostrum in 915 individuals of *Palæmonetes varians* Leach from Saltram Park, near Plymouth, England. When I learned from Dr. Davenport that these numbers are markedly higher in the closely allied, if not identical, species, *Palæmonetes vulgaris* Herbst, at Cold Spring Harbor, I took up the investigation of 1050 individuals of the latter form in order to try, in at least one case, which opinion held true. If there existed any relation between average and variability, the latter ought to be sensibly higher in *P. vulgaris* than in *P. varians*. If I was right, the variability of the number of rostral spines, in spite of the higher average in *P. vulgaris*, ought to be about the same in both species.

I shall follow Weldon and deal with the males and females together, for among the 1050 individuals caught in the seine, only 92 were males. The males are much smaller than the females. The empirical results obtained from *P. vulgaris* are given in a table of combinations, those of *P. varians* (for comparison) in series of variations.

Explanation of letters used in the tables :

f, empirical, *y*, theoretical frequencies ; *n*, total number of individuals investigated ; Δ, error between empirical and theoretical series of variation in percentages of *n* ; *A*, arithmetic

TABLE I. — COMBINATIONS IN PALÆMONETES VULGARIS.

Dorsal spines		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	*Palæmonetes vulgaris*	*Palæmonetes varians*
Ventral spines	0				1	2	1	1	2								7	3
	1						1	2	2	1							5	276
	2							1	15	31	8	1					57	630
	3							4	79	513	287	36					919	6
	4								1	21	28	7	1		1		59	$n = 915$
	5												1	2			3	
Palæmonetes vulgaris	*f.*				1	2	2	8	99	566	323	44	2	2	1		$n = 1050$	
	y.			.1	.2	.7	2.7	14.5	106.2	548.2	330.0	40.8	5.3	1.0	.3	.1	$\Delta = 1.63\%$	$\Delta\sqrt{n} = .5297$
Palæmonetes varians	*f.*		2	18	123	372	349	50	1	$n = 915$								
	y.	.1	1.7	18.3	122.2	374.6	345.9	51.7	.5	$\Delta = .31\%$ $\Delta\sqrt{n} = .0949$								

TABLE II. — CONSTANTS OF VARIATION.

	P. VULGARIS.		P. VARIANS.	
	DORSAL SPINES.	VENTRAL SPINES.	DORSAL SPINES.	VENTRAL SPINES.
A	8.2819	2.9781	4.3137	1.6984
ϵ	.8145	.4477	.8627	.4799
M	8.3079	3.1391	4.4634	
G	8.2395		4.2158	
δ	.8379		.9137	
a	1.4666		4.5457	
m	3.1260		42.2128	
τ	.2357		114.5962	
yo	623.86		.212733–25	
V	8.3632		10.6333	
$c.v.$	9.83%	15.03%	20.00%	28.26%

mean ; ϵ, index of variability = root of average square deviation from arithmetic mean ; M, mode = abscissa of maximum ordinate (ym) of the theoretical curve ; G, geometric mean ; $\delta = \sqrt{A^2 - G^2}$ (see Duncker ['99], p. 38) ; a, standard dimension of abscissa ; m, τ, exponents ; yo, ordinate of origin of theoretical curve ; θ, abscissa to yo ; $c.v.$, coefficient of variation = $100\,\epsilon : A$.

The theoretical curves, the polygons of which are represented in Pl. I, *C, D,* by dotted lines, belong to type IV, Pearson ('95) ; they are of the form,

$$y = yo\,(\cos\theta)^{2m} e^{-\tau\, tg\,\theta},$$

where $tg\,\theta = \frac{x}{a}$ x means deviation from θ, and have been calculated by the method A (moments not modified) of Davenport ('99).

From this table we get the following results. The dorsal spines are much more numerous in both species than the ventral ones, and their variability is 1.8 times higher than that of the latter. The mean values of the homologous characters are about twice as large in *P. vulgaris* as in *P. varians ;* nevertheless, the indices of variability are nearly equal in both species, in *P. vulgaris* even a little lower than

in *P. varians*. Judging from the coefficient of variation, however, we should find the numbers of ventral spines more variable than those of the dorsal ones, and the homologous characters only half as variable in *P. vulgaris* as in *P. varians*. Thus the coefficients of variation give quite different results from those obtained from the indices of variability, and only the latter ones, as Pl. I shows, correspond to the real conditions of variation in the four characters compared. *Therefore, in our examples, the indices of variability alone, not the coefficients of variation, are morphologically significant, and the former are similar in homologous characters, but independent of their mean values.*

The numbers of dorsal spines vary regularly, according to type IV of Pearson ('95) in both species with negative asymmetry of the variation curves, that is, the modes are higher than the means. It is remarkable that the ordinate of origin of the curve of *P. varians* lies at 10.63 of the abscissa, even higher than the mean and the ordinate of origin of *P. vulgaris*. Since both species, wherever they occur, are represented by immense numbers of individuals, their range of variation in the character considered probably extends much farther than will be expected from the empirical results of the investigations made by Weldon and myself. The variation curve in *P. vulgaris* is more symmetrical than that of *P. varians*, according to its small t-value. In both cases the agreement between the empirical series of variations and the theoretical one is thoroughly satisfying, the area of error between their two polygons remaining far behind its allowed upper limit,

$$\Delta\% = \frac{100}{\sqrt{n}}.$$

The numbers of ventral spines vary irregularly, which may partly be due to their small variability. In *P. varians* we find a curve of type I (asymmetrical, limited to both sides), where, however, the value $5\beta_2 - 6\beta_1 - 9$ is negative,[1] and where, accordingly, the index of asymmetry of this curve has a different sign from its third moment about the mean. In

[1] For explanation of these symbols, see Davenport ('99), or Duncker ('99).

P. vulgaris we get a curve of type IV, showing considerable asymmetry of its slope, probably in consequence of the abnormal frequency of the zero variant, while the empirical polygon of variation apparently corresponds to a nearly symmetrical curve. Of course there is no agreement between these curves and the empirical series of variation.

The correlation between the numbers of dorsal and ventral spines in *P. vulgaris* is positive, as is the rule in antimerically arranged homologous characters; its coefficient $r = .3878 \pm .0177$.

Besides variation in the number of spines there are some more individual differences in the shape of the rostrum of *P. vulgaris*, which will be seen from Figs. 2–27. The total rostrum may be compared with a knife, the blade of which is serrated on both edges, its handle bearing spines only on the back. In the spaces separating the spines there are feathered hairs in a single series; from the smooth ventral surface two rows of hairs extend from each side downward, like the rafters in a roof. In the males (Figs. 2–5) the rostrum is generally more slender and its handle longer than in the females (Figs. 6–27). While in *P. varians* Weldon found the apex of the rostrum bifid in more than half (52.8%) of all the individuals investigated, in our *P. vulgaris* it always was single-pointed.

With increasing numbers the spines stand together more closely and extend more forward to the apex of the rostrum (*cf.* Figs. 17 and 19 with Figs. 6 and 7); in case of very high numbers (extreme variation) they are sometimes irregularly arranged and of different sizes (Figs. 14–16, 18). Spines are rarely bifid (Fig. 13, third ventral), reduced (Fig. 20, between second and third dorsal; Fig. 21, behind first ventral) or entirely absent in a part of the otherwise normal rostrum (Fig. 22, between second and third dorsal). Very frequently, however, especially among the smaller numbers of spines, one meets with curious malformations (Figs. 5, 23–27), apparently due to regeneration, the rostrum, on account of its exposed situation, suffering easily from traumatic injuries. It would be interesting to learn if in the course of several moltings the

rostrum regenerates typically, that is, according to its individual variation of shape and of number of spines.

LITERATURE.

'97 BREWSTER, E. T. A Measure of Variability and the Relation of Individual Variations to Specific Differences. *Proc. Amer. Acad. Arts, Sci.* Vol. xxxii, No. 15, pp. 268–280.

'99 DAVENPORT, C. B. Statistical Methods, with Special Reference to Biological Variation. New York and London.

'99 DUNCKER, G. Die Methode der Variationsstatistik. *Arch. f. Entwickelungsmechanik.* Bd. viii, Nr. 1, pp. 112–187.

'98 FIELD, W. L. W. A Contribution to the Study of Individual Variation in the Wings of Lepidoptera. *Proc. Amer. Acad. Arts, Sci.* Vol. xxxiii, No. 21, pp. 389–395.

'95 PEARSON, K. Mathematical Contributions to the Theory of Evolution. II. Skew Variation in Homogeneous Material. *Phil. Trans. Roy. Soc.* Vol. clxxxvi, No. 153, pp. 343–414, 10 plates. London.

'97 PEARSON, K. On the Scientific Measure of Variability. *Nat. Sci.* Vol. xi, No. 66, pp. 115–118.

'94 VERSCHAEFFELT, E. Ueber graduelle Variabilität von pflanzlichen Eigenschaften. *Berichte Deutsch. Bot. Ges.* Bd. xii, Heft 10, pp. 350–355.

'92 WELDON, W. F. R. Palæmonetes varians in Plymouth. *Journ. Mar. Biol. Assoc. Un. Kingd.* N. S., Vol. 1, No. 2, pp. 459–461.

EXPLANATION OF PLATE I.

Pl. I. Polygons of variation of numbers of spines; empirical polygons are given by continuous, theoretical ones by dotted lines.

A, ventral spines of *P. varians*.

B, ventral spines of *P. vulgaris*.

C, dorsal spines of *P. varians*.

D, dorsal spines of *P. vulgaris*.

ϵ, index of variability of polygon above.

ya, *ym*, *yo*, ordinates of theoretical curves to *A*, *M*, *O*, of abscissa; compare explanation of letters used in table, p. 624.

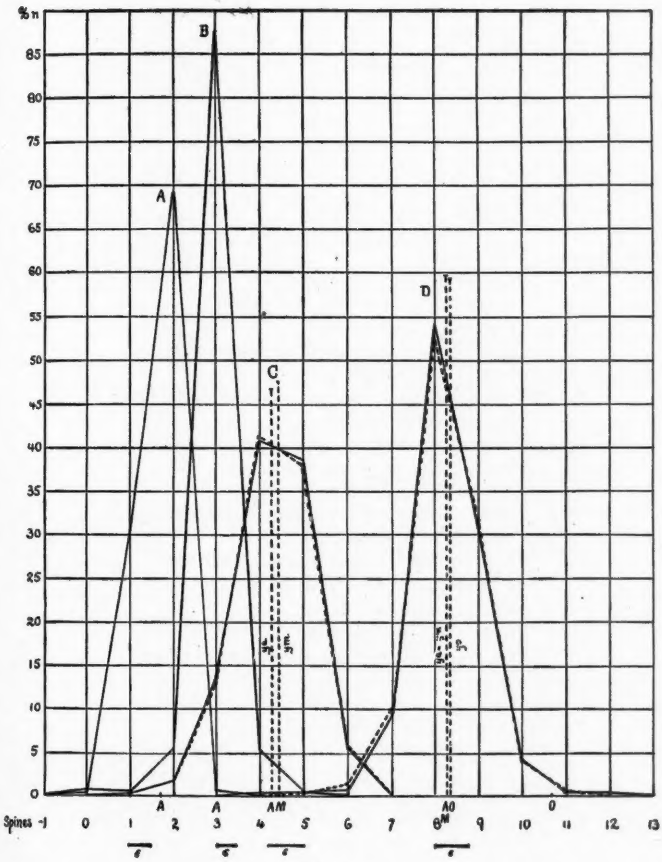

% n
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
A
B
C
D
Spines -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13

PLATE I.

EXPLANATION OF PLATE II.

Camera drawings of rostra.
(Leitz, Oc. 1; Zeiss Obj. A,* II.)
FIGS. 2–5. Male rostra.
FIG. 2. Normal, 6 dorsal, 3 ventral spines.
FIG. 3. Normal, 9d. 3v.
FIG. 4. Irregular, 8d. 1v.
FIG. 5. Malformed, 5d. 0v.
FIGS. 6–22. Normal female rostra.
FIG. 6. Normal, 5d. 2v.
FIG. 7. Normal, 6d. 3v.
FIG. 8. Normal, 6d. 3v. (sixth dorsal broken).
FIG. 9. Normal, 7d. 3v.
FIG. 10. Small irregularities in
FIG. 11. position of spines, 7d. 3v.
FIG. 12. Normal, 7d. 4v.
FIG. 13. Third ventral bifid, 8d. 3v.
FIG. 14. 10d. 3v. irregular position of spines.

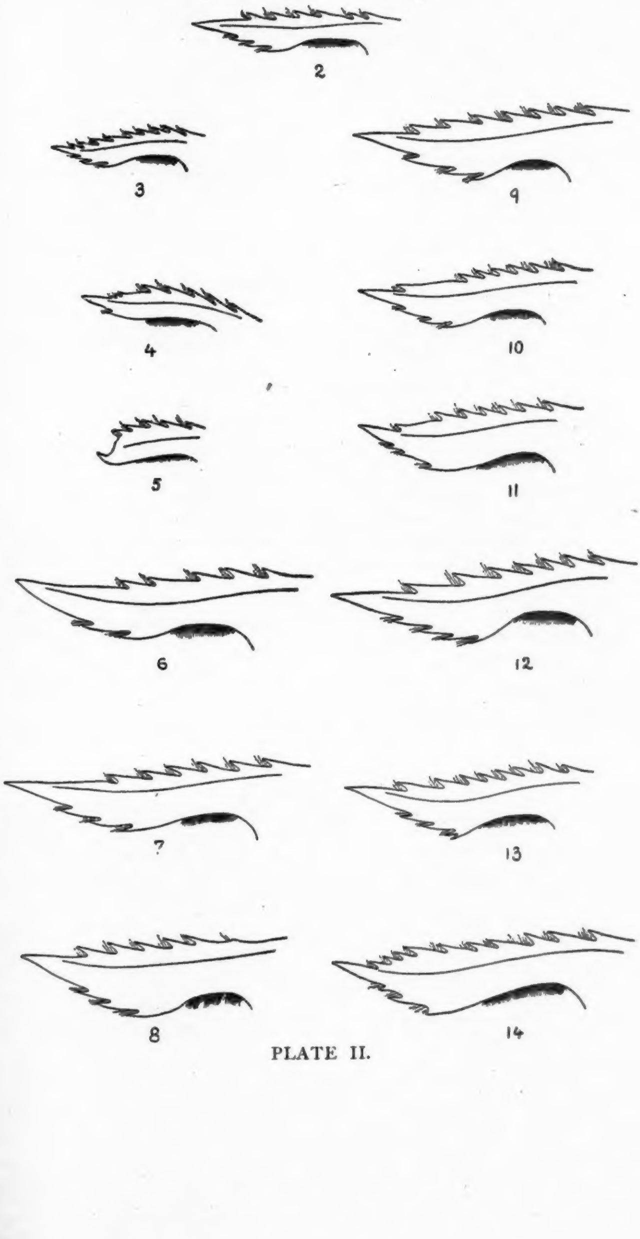


PLATE II.

EXPLANATION OF PLATE II (*Continued*).

FIG. 15. 10d. 4v. } irregular position of spines.
FIG. 16. 12d. 5v. }
FIG. 17. Normal, 12d. 5v.
FIG. 18. Irregular position of spines, 12d. 6v. (not in table ; found later).
FIG. 19. Normal, 13d. 4v.
FIG. 20. Some spines reduced, 6d. 3v.
FIG. 21. Some spines reduced, 7d, 1v.
FIG. 22. Some spines missing, 5d. 3v. (abnormally small).
FIGS. 23–27. Malformed female rostra.
FIG. 23. 8d. 3v.
FIG. 24. 8d. 3v.
FIG. 25. 7d. 3v.
FIG. 26. 6d. o(?)v.
FIG. 27. 4d. ov.

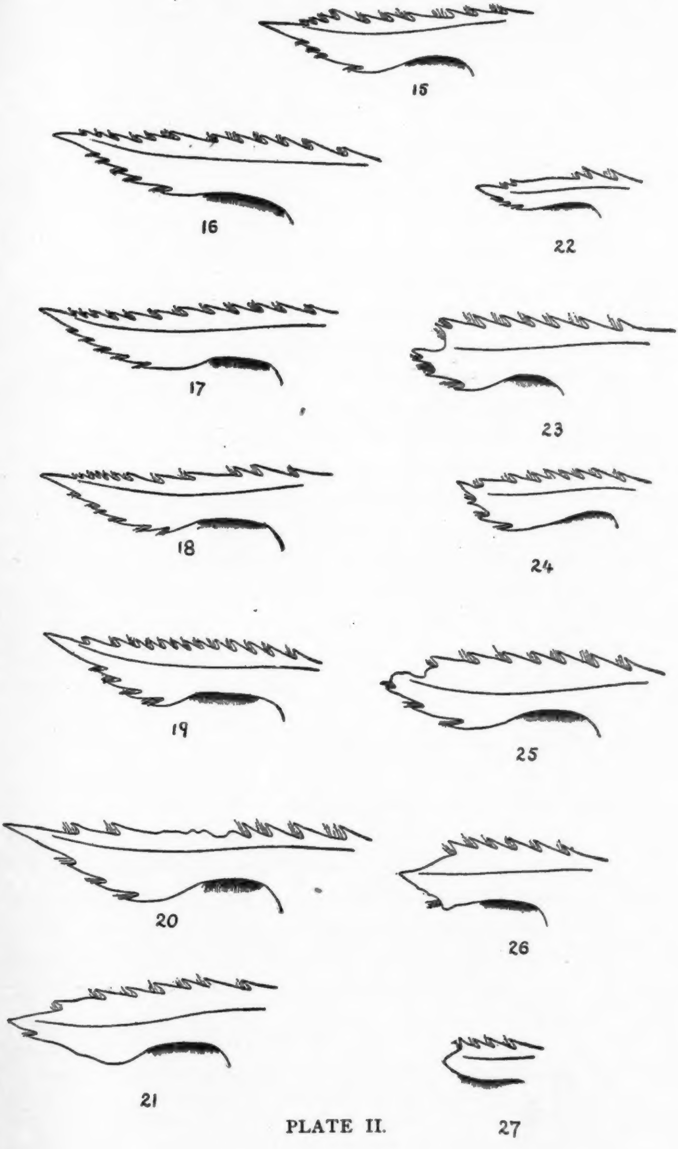


PLATE II.

SOME ADDITIONAL DATA ON THE POSITION OF THE SACRUM IN NECTURUS.

FRANK SMITH.

THREE papers[1] which deal incidentally with the position of the sacrum in *Necturus maculosus* Raf. have appeared within recent years, in each of which are mentioned several instances of variation from the typical symmetrical sacrum on the nineteenth vertebra, and they record observations on 158 specimens. The use of *N. maculosus* as an object of study in some of the zoölogical classes of the University of Illinois has made it easy to accumulate additional information on the position of the sacrum in this species, and since data of this kind have a recognized value, and since certain variations from the normal condition have been found which have not been previously reported, it seems worth while to publish a brief account of the relations of the sacrum in the 114 specimens which have been examined in our laboratories. The material was all obtained from Lake Erie, near Sandusky, Ohio, during the years 1897–99.

Table I presents in a convenient form the data from the above-mentioned specimens, but as thirty-two of them were not examined for the position of the first hæmal arch they are tabulated in a separate column.

For convenience in a comparison of the various observations mentioned, Table II has been prepared. It relates to 241 specimens — the 158 specimens previously recorded, the eighty-two specimens listed in Table I, in which the position of the first hæmal arch is known, and one other specimen listed in that

[1] Parker, G. H. Variations in the Vertebral Column of Necturus, *Anat. Anzeiger*, Bd. xi, pp. 711–717.

Bumpus, H. C. A Contribution to the Study of Variation (Skeletal Variations of Necturus maculatus Raf.), *Journ. of Morph.*, vol. xii, pp. 455–484, 3 pls.

Waite, F. C. Variations in the Brachial and Lumbro-Sacral Plexi of Necturus maculosus Raf., *Bull. Mus. Comp. Zoöl.*, vol. xxxi, No. 4, pp. 71–92, 2 pls.

table, in which the position of the first hæmal arch is unknown, but which has three sacral ribs.

TABLE I.[1]

Vertebra which carries Sacrum.	Number of Specimens.	First Hæmal Arch on Vertebra 22.	Vertebra 23.	Vertebra 24.	Vertebra ?
XIX	81	30	33		18
XX	16		4	2	10
XXI	1			1	
R. XVIII . . . L. XIX	2	2			
R. XIX . . . . . L. XVIII . . .	1	1			
R. XIX . . . . . L. XX	3		3		
R. XX . . . . . L. XIX	6		2	1	3
R. XVIII . . . L. XVIII, XIX	1	1			
R. XIX . . . . . L. XIX, XX . .	2		1		1
R. XIX, XX . . L. XIX	1		1		
Total	114	34 = 41 % of 82	44 = 54 % of 82	4 = 5 % of 82	32

Some of the data listed in the above tables deserve further mention. One of the most striking points is the occurrence of as many as five individuals having three sacral ribs. Waite mentions one such instance, which I think is the only one previously recorded for *N. maculosus*, while among the 114 individuals examined by us there are four such cases. One of these has, as an additional peculiarity, two sacral ribs on the eighteenth vertebra, and is the first one recorded in which that vertebra is invaded on both sides. The figure shown on p. 638 represents the eighteenth, nineteenth, and twentieth vertebræ

[1] R. and L. are used as abbreviations for right and left.

TABLE II.[1]

Character and Position of Sacrum.	No. of Specimens Recorded by			241 Specimens.
	Parker.	Bumpus.	Waite.	
Symmetrical.				
XIX — 22	4	10	10	54
XIX — 23	15	52	10	110
XIX — 24		2		2
XX — 22		1		1
XX — 23	6	24	7	41
XX — 24		3		5
XXI — 24				1
Asymmetrical.				
R. XVIII, L. XIX — 22		1	2	5
R. XIX, L. XVIII — 22				1
R. XIX, L. XX — 23			1	4
R. XX, L. XIX — 23	1	7		10
R. XX, L. XIX — 24				1
R. XXI, L. XX — 24	1			1
R. XVIII, L. XVIII, XIX — 22				1
R. XIX, XX, L. XIX — 23			1 [2]	2
R. XIX, L. XIX, XX — 23				2 [3]

with the sacral ribs and ilia from the dorsal side. The dotted lines indicate the outlines of the cartilage and other tissue forming the articulations between the ilia and sacral ribs, as

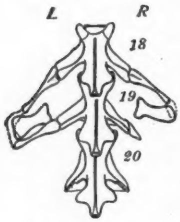
[1] The Arabic numerals are used to designate the vertebra bearing the first hæmal arch.

[2] The position of the first hæmal arch of this specimen is not recorded.

[3] The position of the first hæmal arch in one of these specimens is unknown.

seen in the dried skeleton. The two sacral ribs on the left side are about equal in size and share alike in the support of the ilium.

The other four specimens having three sacral ribs, listed in Table II, each have paired sacral ribs on the nineteenth vertebra, while the unpaired sacral rib is borne on the right side of the twentieth vertebra in two of them, and on the left side in the other two. Twenty-five specimens are listed which have an asymmetrical sacrum with but two sacral ribs, and in nine of these the sacral rib of the right side is further cephalad, while in the remaining sixteen it is the left sacral rib which is in advance. It seems curious that in the first ten specimens which were reported as having this condition of the sacrum, nine should have had the left side in advance, while in the next fifteen over half of them should have the right side in advance; and again it is singular that, of six specimens in which the eighteenth vertebra is invaded, five of them should have the right side in advance, while in the remaining nineteen cases fifteen should have the left side in advance. It is evident that data from a much larger number of specimens must be obtained before trustworthy generalization can be made.



One individual found during the past winter and listed above has a symmetrical sacrum on the twenty-first vertebra, a condition not previously recorded, I believe; and in one specimen described by Parker this vertebra was invaded on the right side; but these two specimens are the only ones, so far as I know, in which the twenty-first vertebra is invaded by the sacrum.

I am under obligations to Mr. Ralph G. Mills, a student at the University, for making the drawing for the figure, and also for the examination of a considerable number of the specimens studied.

UNIVERSITY OF ILLINOIS.

A STRANGE ABNORMALITY IN THE CIRCULATORY SYSTEM OF THE COMMON RABBIT (LEPUS SYLVATICUS).

JAMES ROLLIN SLONAKER.

In the March number of the *Naturalist* an article appeared "On the Frequency of Abnormalities in Connection with the Postcaval Vein and its Tributaries in the Domestic Cat (Felis domestica)." Such variations are quite familiar to those who have charge of laboratory work in vertebrate anatomy. The abnormalities are, however, by no means confined to the region indicated in the above article. They are common to other parts of the circulatory system.

Though the author does not discuss the probable causes of these abnormalities, he suggests that they may be due in part to "domestication, in breeding, disease, drugs, and shock."

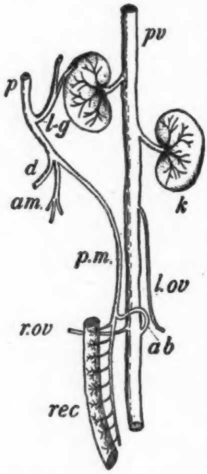
I have found that abnormalities in the circulatory system are not confined to the domesticated cat, but are also of frequent occurrence in the common gray rabbit.

The most noticeable variation that I have found, and the only one which I shall describe, was found in the venous system of the rabbit. I have found it but once and, as I have seen no mention of such an occurrence in the literature pertaining to this subject, I will describe it.

In injecting the posterior vena cava from the heart I was amazed by the rapid filling of the portal veins. This continued until they were as well injected as the other veins of the body. The injecting fluid used was a starch mass which was too coarse to pass from the vena cava through the capillaries of the liver into the portal vein. The inference was that there was a vein of sufficient size forming a direct connection between the portal vein and the posterior vena cava.

Careful dissection showed this supposition to be true. A small vein extended from the posterior mesenteric and united

with the posterior vena cava on the left side, just opposite the right ovarian vein. This connecting branch was not modified from some of the branches of the vena cava normally belonging to this region, since these were all present. It may possibly have been one of the original branches composing the posterior mesenteric which had in some way become attached to the vena cava.



a.b., abnormal connecting vein; *a.m.*, anterior mesenteric vein; *d.*, duodenal vein; *k.*, kidney; *l.-g.*, lieneo-gastric vein; *l.ov.*, left ovarian vein; *p.*, portal vein; *p.m.*, posterior mesenteric vein, *p.v.*, posterior vena cava; *rec.*, rectum; *r.ov.*, right ovarian vein.

Some correlation might be made with the birds, since they have the portal vein and the posterior vena cava normally connected by the posterior mesenteric and the hypogastric veins. Such is, however, not justifiable, for this is, so far as I know, the only record of such an existence in mammals. It is best, therefore, to consider it strictly as an abnormality and in no sense a reversion to some possible past condition.

In conclusion I may add that, though no attempt will be made to account for the causes leading to these abnormalities in cats and rabbits, I do not feel that domestication should be mentioned as a possible cause, since these variations occur as frequently in the wild rabbit as in the domesticated cat.

THE ORIGIN OF THE MIDDLE OCELLUS OF THE ADULT INSECT.

(Preliminary Communication.)

CHUJIRO KOCHI.

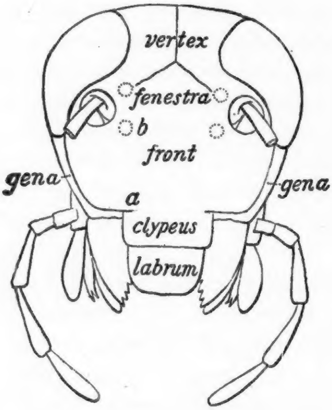
Many years have passed since Leydig and Brandt called attention to the fact that one of the three ocelli in the adult insect situated in its median line was double. I do not know whether there exists to-day any accurate theory of the origin of this middle ocellus. Most entomologists have simply regarded it as the fusion of two ocelli which once occurred separately in the ancestral form. If this theory is true, there must be some relics left in the generalized type of the insect by which we may trace out the original number of the ocelli, *i.e.*, two pairs in all.

Among all the orders of the insects the Orthoptera is perhaps the most generalized one. Among the Orthoptera I shall refer to the cockroach as being one of the oldest, least modified, and, in many ways, very instructive for comparing it with the other specialized forms of insects.

The head of the cockroach (*Blatta orientalis*) is vertically elongated, having a semicircular outline above, and narrowing downwards. The dorsal part of the head is the vertex, and a median suture may be seen traversing it from before backward, and dividing between the eyes into two branches, one of which passes toward the articulation of each antenna to form a *V*-shaped suture. The cephalic portion of this suture is the front, which was called the "clypeus" by Huxley, as well as by Miall and Denny in their work on the anatomy of this insect. Perhaps they did not notice that the clypeus was a small sclerite, situated above the labrum, and separated from the front by a curved suture at the point *a*. This suture also divides the gena from the front on each side of the head.

The basal joint of the antenna is articulated with the front by a transparent flexible membrane, the antennary fossa, and allows of the free play of the antenna. On the inner side of and above the antennary fossa there is a peculiar membranous area of paler color — the fenestra. According to Sedgwick this fenestra is replaced by an ocellus in some cockroaches (the males of Corydia and Heterogamia). If so, we must regard this fenestra as a rudimentary ocellus.

A little below the fenestra, and in the broad, flattened region of the front, there is another peculiar spot marked *b*,



which seems to have escaped the notice of all observers. This spot is, however, more prominent than the fenestra, and it looks like one of the originally paired ocelli, which afterward migrated toward the median line and fused together to form a middle ocellus in other insects.

There often occur some perplexing dark spots in the head of the insects, surrounding their ocelli, but they vary a great deal in size and number as well as in shape and position. But in the cockroach these four spots are always present throughout all the species I have examined. Two of them are regularly situated in the vertex, near its cephalic margin (sometimes they are situated on the boundary line between the vertex and

the front), while the other two are seen in the front, a little below the antenna.

This peculiar appearance of the four spots led me to investigate the occurrence of the original four ocelli. In deciding this question I have made several microtome sections and stained them by the various methods. The preparations have not only shown the connection of the nervous system with these four spots, but their histological characters threw a light upon the nature of their origin as the optical organs.

The complete account of my studies on this subject, with some illustrations, may be published in the near future; therefore I shall leave only the preliminary statement here for the present.

Cornell University, Ithaca, N. Y.,
June 10, 1900.

SYNOPSES OF NORTH-AMERICAN INVERTEBRATES.

XII. The Trematodes.

PART I.—THE HETEROCOTYLEA OR MONOGENETIC FORMS.

H. S. PRATT.

The order Trematoda was established in the year 1808 by Rudolphi, who included in it the following genera: *Monostoma* Zeder, *Amphistoma* Rudolphi, *Distoma* Retzius, and *Polystoma* Zeder. During the succeeding half century, when the greatest activity was shown in the description of new species of trematodes, numerous attempts were made by Von Nordmann, Dujardin, Diesing, Leuckart, and others to arrange them in a system of classification which would express their natural relationships. But lack of accurate information on their anatomy and development led, at one time and another, to numerous errors, such as the inclusion among trematodes of pentastomes, planarians, and leeches, and the description of larval forms for adult animals. Thus, it was not until the year 1858 that a system was constructed which was a satisfactory solution of the problem, and the one which is the foundation of the system in general use to-day. In that year P. J. van Beneden proposed the names "Monogenea" for those trematodes which develop without metamorphosis, and "Digenea" for those which develop with metamorphosis, the former being, for the most part, ectoparasites, and the latter, endoparasites. The great additions, however, which have been made in recent years to our knowledge of trematodes have rendered it increasingly difficult to use these distinctions satisfactorily, and consequently, in 1892, Monticelli proposed an entirely new system, in which trematodes are divided into three groups or suborders, the Heterocotylea, Aspidocotylea, and Malacocotylea, the first

of which exactly coincides with the Monogenea of van Beneden, while the second and third are included in the Digenea. This arrangement has been generally adopted by recent authors, and this synopsis is based upon it.

The following are the families, subfamilies, and genera of the suborder Heterocotylea in Monticelli's system of classification, with certain modifications, however, which have been proposed since 1892 by himself, Braun, Cerfontaine, Goto, Saint-Remy, and others:

Order. — Trematoda Rud.

Suborder I. Heterocotylea Mont.

Family I. Temnocephalidæ Hasw.

Subfamily I. Temnocephalinæ Mont.

Genera: Temnocephala, Craspedella, Dactylocephala.

Subfamily II. Actinodactynellinæ Mont.

Genus: Actinodactylella.

Family II. Tristomidæ Taschbg.

Subfamily I. Tristominæ Mont.

Genera: Tristoma, Nitzschia, Epibdella, Phyllonella, Trochopus, Acanthocotyle, Placunella.

Subfamily II. Encotyllabinæ Mont.

Genus: Encotyllabe.

Subfamily III. Udonellinæ Mont.

Genera: Udonella, Echinella, Pteronella.

Family III. Monocotylidæ Taschbg.

Genera: Monocotyle, Calicotyle, Lophocotyle, Dionchus, Merizocotyle, Microbothrium, Pseudocotyle.

Family IV. Polystomidæ Taschbg.

Subfamily I. Polystominæ v. Ben.

Genera: Polystoma, Erpocotyle, Onchocotyle, Diplobothrium, Sphyranura.

Subfamily II. Octocotylinæ v. Ben. et Hesse.

Genera: Octocotyle, Octobothrium, Dactylocotyle, Diclidophora, Anthocotyle, Vallisia, Diplozoön, Phyllocotyle, Hexacotyle, Plectanocotyle, Platycotyle, Pleurocotyle.

Subfamily III. Microcotylinæ Taschbg.

Genera: Microcotyle, Gastrocotyle, Axine, Pseudaxine.

Family V. Gyrodactylidæ v. Ben. et Hesse.

Genera: Gyrodactylus, Dactylogyrus, Tetraonchus, Diplectanum, Calceostoma, Amphibdella, Dactylodiscus, Fridericianella, Anoplodiscus.

ORDER. — TREMATODA RUD.

Small parasitic flatworms, with unsegmented, flattened or cylindrical, unciliated bodies, with usually anterior mouth-opening and bifurcate intestine, and without anal opening, which attach themselves to their hosts by means of suckers, or hooks, or both.

KEY TO THE SUBORDERS.

A_1. Usually ectoparasitic trematodes living upon the external surface or the gills, or in the mouth or cloaca of aquatic animals (except genus Polystoma), to which they attach themselves by means of suckers, or hooks, or both; suckers, when present, are usually near either one or both ends of the body; when at the anterior end, in most cases, a single pair is present; when at the posterior end, in most cases, one or more pairs are present, or, in their place, a sucking disk . . . . Heterocotylea Mont.

A_2. Endoparasitic trematodes which attach themselves to their hosts either by means of one or more median (unpaired) suckers or a large ventral sucking disk; hooks never present.

B_1. Either a large ventral sucking disk or a mid-ventral row of suckers present; no oral sucker; intestine not bifurcate (except possibly Aspidocotyle) . . . . . . Aspidocotylea Mont.

B_2. Either one or two or, in a few cases, more than two median suckers present; an oral sucker invariably present (except Gasterostomum); intestine, except in rare cases, bifurcate Malacocotylea Mont.

KEY TO THE FAMILIES, SUBFAMILIES, AND GENERA OF THE HETEROCOTYLEA.

a_1. Body with four to twelve finger-like tentacles at anterior end or on lateral sides, and with a posterior sucker; lives on the outer surface of tropical fresh-water crustaceans and turtles, and in the branchial cavity of a mollusk (Ampullaria) . . Family I. Temnocephalidæ

b_1. Tentacles all preoral . . . . . Subfamily I. Temnocephalinæ

c_1. Tentacles four to six in number; sucker subterminal; two pairs testes.

d_1. Dorsal surface without lamellæ; pharynx distinct Temnocephala Blanch. (Fig. 1)

d_2. Dorsal surface with several transverse lamellæ; pharynx rudimentary . . . . . Craspedella Hasw. (Fig. 2)

c_2. Tentacles twelve in number; sucker very small; one pair lobed testes; pharynx distinct . . . . Dactylocephala Mont.

b_2. Tentacles not all preoral . . Subfamily II. Actinodactynellinæ

Tentacles twelve in number at sides and anterior end of pear-shaped

body; 2 pairs testes; sucker-like pit near mouth; mouth with proboscis; pharynx distinct . . . Actinodactylella Hasw. (Fig.

a_2. Body without four to twelve finger-like tentacles.

b_1. Body usually broad and flattened, sometimes elongate or cylindrical, with a single ventral or terminal posterior sucking disk, usually of large size and armed with hooks and with or without radial ridges; paired anterior suckers either present or not.

c_1. Paired anterior suckers present or in their place a pair of projections (or a pair of glandular depressions, Goto)
Family II. Tristomidæ

d_1. Body elliptical or circular and flattened.

e_1. Sucking disk large, with or without radial ridges, and either sessile or with short stalk; genital pores in most cases on left . . Subfamily I. Tristominæ

f_1. Genital pores on left.

g_1. Sucking disk without radial ridges; four eyes.

h_1. Anterior suckers present.

i_1. Body elongate; sucking disk terminal, with (or without, Linton) numerous minute hooks; testes numerous: in branchial cavity of marine fishes
Nitzschia v. Baer (Fig. 4)

i_2. Body elliptical; sucking disk ventral, with three (two, Linton) pairs of hooks of unequal size and often with papillæ; two testes: on the skin of marine fishes
Epibdella Blain. (Fig. 5)

h_2. Anterior suckers not present, in their place a paired membrane; sucking disk with two pairs of hooks; two testes: on the skin of marine fishes
Phyllonella v. Baer (Fig. 6)

g_2. Sucking disk with radial ridges; eyes present or not; anterior suckers present.

h_1. Sucking disk with nine radial ridges and two large hooks; two testes; four eyes; body elliptical: on gills of marine fishes
Trochopus Dies. (Fig. 7)

h_2. Sucking disk with four to six faintly marked radial ridges and two or three pairs of hooks; two testes; four eyes; body elongate: on skin of marine fishes
Placunella v. Ben. et Hesse (Fig. 8)

h_3. Sucking disk with seven radial ridges;

body very broad, often circular ; no eyes ; numerous testes : on gills or skin of marine fishes Tristoma Cuv. (Fig. 9)

f_2. Genital pores median or on right. Sucking disk with numerous radial rows of small hooks ; anterior suckers present (or in their place a pair of glandular depressions, Goto) ; numerous testes : on the skin of the skate

Acanthocotyle Mont. (Fig. 10)

e_2. Sucking disk joined to body by a long stalk ; genital pores median . . . Subfamily II. Encotyllabinæ

Body elliptical ; anterior suckers large, stalked ; sucking disk without radial ridges and with two hooks : in mouth of marine fishes

Encotyllabe Dies. (Fig. 11)

d_2. Body elongate, cylindrical, and sometimes ringed ; sucking disk terminal, without radial ridges or hooks ; pharynx extensible ; genital pores median ; no eyes : on parasitic crustaceans . . . . . Subfamily III. Udonellinæ

e_1. Anterior suckers present ; body ringed in youth ; pharynx without hooks ; one testis : on Caligus and Anchorella. . . . . Udonella Johnst. (Fig. 12)

e_2. Anterior suckers absent, but in their place a pair of projections : on Caligus.

f_1. Body ringed ; anterior projections narrow, tentacle-like ; pharynx with two hooks

Echinella v. Ben. et Hesse (Fig. 13)

f_2. Body ringed in youth, swollen in middle ; anterior projections broad, membranous ; pharynx without hooks, but with a large number of minute rods

Pteronella v. Ben. et Hesse (Fig. 14)

c_2. Paired anterior suckers or projections absent ; sucking disk with or without radial ridges ; body flattened and usually broad

Family III. Monocotylidæ

d_1. Sucking disk very small, without radial ridges or hooks : on skin of selachians.

e_1. Body elliptical, with truncated ends ; vagina paired ; testes usually numerous

Pseudocotyle v. Ben. et Hesse (Fig. 15)

e_2. Body elliptical, with attenuated ends ; vagina unpaired, opening on left of ventral surface ; one large testis.

Microbothrium Ols. (Fig. 16)

d_2. Sucking disk large, with radial ridges and (except in Lophocotyle) two hooks ; paired adhesive glands at anterior end.

e_1. Anterior glandular areas large and prominent, one on each side of anterior end.

f_1. Body elongate; sucking disk nearly circular and containing one central, eighteen peripheral, and seven intermediary depressions; one very large testis: on skin of skates

Merizocotyle Cerf. (Fig. 17)

f_2. Body elongate; four eyes; sucking disk elliptical, with ten radial ridges; two testes; no vagina: on gills of Remora . Dionchus Goto (Fig. 18)

f_3. Body ovoid; sucking disk circular, with numerous radial ridges, with no large, but a group of minute, hooks on its edge; testes numerous: on skin of marine fishes . . Lophocotyle Braun (Fig. 19)

e_2. Anterior glandular areas inconspicuous.

f_1. Body heart-shaped; sucking disk with seven radial ridges; testes numerous: on skin and in the cloaca of marine fishes

Calicotyle Dies. (Fig. 20)

f_2. Body elongate; sucking disk with eight radial ridges; three testes: on skin of marine fishes

Monocotyle Taschbg. (Fig. 21)

b_2. Body usually elongate and flattened, though sometimes broad, with a more or less distinct disk-like region at hinder end, bearing either suckers, or hooks, or both; paired anterior suckers either present or absent.

c_1. Posterior disk-like region with suckers, usually paired, and, in most cases, with hooks; anterior paired suckers either present or absent.

d_1. Posterior region with either two or six suckers; paired anterior suckers absent . . Subfamily I. Polystominæ

e_1. Posterior region with two (one pair) large suckers and two large hooks; body elongate: on skin of Necturus . . . . Sphyranura R. R. Wr. (Fig. 22)

e_2. Posterior region with six (three pairs) suckers and with or without a terminal projection.

f_1. Posterior region without a terminal projection; body rather broad; vagina paired, with an opening on either side of body: on gills and in urinary bladder of amphibians, and in mouth, nose, and urinary bladder of turtles

Polystoma Zeder (Fig. 23)

f_2. Posterior region with a terminal projection.

g_1. Posterior disk-like region bearing the suckers is oval, the terminal projection is rather wide

and bears two hooks; body elongate: on gills of Mustelus

Erpocotyle v. Ben. et Hesse (Fig. 24)

g_2. Suckers stalked; terminal projection narrow, with four hooks; body attenuated: on gills of Accipenser

Diplobothrium F. S. Leuck. (Fig. 25)

g_3. The terminal projection is bifid at its extremity, each half bearing a small sucker; body elongate: on gills of selachians

Onchocotyle Dies. (Fig. 26)

d_2. Posterior region with four to eight large suckers; paired anterior suckers present . Subfamily II. Octocotylinæ

e_1. Posterior region with four (five) suckers.

f_1. Posterior region with two pairs of suckers at the end of long stalks; body elongate: on gills of marine fishes

Platycotyle v. Ben. et Hesse (Fig. 27)

f_2. Posterior region with four suckers in a lateral, longitudinal row, to which may be added a fifth smaller sucker on the opposite side; body elongate and asymmetrical: on gills of marine fishes (Scomber) . . . Pleurocotyle Gerv. (Fig. 28)

e_2. Posterior region with six (three pairs) suckers.

f_1. Body elongate; posterior region with the six suckers bears at its posterior end a tail-like projection, at the extremity of which is a single sucker: on gills of marine fishes

Phyllocotyle v. Ben. et Hesse (Fig. 29)

f_2. Body either elongate or broadly elliptical; suckers on the broad posterior margin, in the median line of which, between the median suckers, a pair of hooks on a short projection may or may not be present: on gills of marine fishes

Plectanocotyle, Dies. (Fig. 30)

e_3. Posterior region with eight (four pairs) suckers.

f_1 Individuals fused together, *x*-shaped, in pairs; body elongate; posterior suckers sessile: on gills of fresh-water fishes Diplozoön v. Nordm. (Fig. 31)

f_2. Individuals not fused together in pairs.

g_1. Body asymmetrical, elongate, composed of two equal portions, which form an angle with each other; posterior suckers sessile: on gills of Lichia

Vallisia Par. et. Per. (Fig. 32)

g_2. Body symmetrical.

h_1. Posterior suckers alike in size.

i_1. Posterior region with median hooks at or near its posterior end; genital hooks with simple points.

j_1. Body usually elongate; posterior suckers with short stalks; intestinal crura do not anastomose; genital hooks arranged in groups; vagina dorsal: on gills of marine fishes, especially the Clupidæ

Octobothrium F. S. Leuck. (Fig. 33)

j_2. Body usually elongate, thick; posterior suckers usually sessile; genital hooks arranged in two lines in pairs; no vagina: on gills of marine fishes, especially the Scomberidæ,

Octocotyle Dies. (Fig. 34)

i_2. Posterior region without median hooks; genital hooks with double points and arranged in a circle.

j_1. Body usually elongate; suckers at the end of long stalks and functioning as pincers; vagina ventral: on gills of marine fishes, especially the Gadidæ

Dactylocotyle v. Ben. et Hesse (Fig. 35)

j_2. Body usually elongate; suckers either stalked or not, and functioning as suckers, each sucker having a characteristic chitinous framework in form of a Greek cross; no vagina: on gills of marine fishes, especially the Sparidæ

Diclidophora (Dies.) Goto (Fig. 36)

h_2. Posterior suckers not alike in size, one pair differing from the others.

i_1. Body elongate; anterior pair of posterior suckers very large, at a distance from the others, projecting from the side of the body; the other three pairs minute, stalked, and grouped

together at the extremity of the body: on gills of marine fishes

Anthocotyle v. Ben. et Hesse (Fig. 37)

i_2. Body elongate; anterior end pointed; posterior end bearing eight sessile suckers at extremity of body, the median pair being smaller than the others: on gills of marine fishes

Hexocotyle Blain. (Fig. 38)

d_3. Posterior region elongate, and bearing numerous small suckers, either paired or not; paired anterior suckers present . . . . Subfamily III. Microcotylinæ

e_1. Body usually symmetrical; posterior suckers paired, numbering from 10 to 120 on a side; no hooks: on gills of marine fishes

Microcotyle v. Ben. et Hesse (Fig. 39)

e_2. Body asymmetrical, one lateral side being more developed than the other, and bearing most or all of the suckers.

f_1. Body tapering anteriorly, widening towards the hinder end, the latter forming, by a one-sided lateral expansion, a broad asymmetrical terminal disk bearing small suckers along its margin.

g_1. Numerous suckers along the longer side of the terminal disk, a small number or none along the other side; no hooks present: on the gills of marine fishes

Axine Abild. (Fig. 40)

g_2. A single row of suckers along the terminal disk, which is prolonged into a spatula-shaped appendix bearing two hooks: on gills of marine fishes (Caranx)

Pseudaxine Par. et Per. (Fig. 41)

f_2. Anterior end of body attenuate, hinder two-thirds widened on one side, on the margin of which is a row of small suckers; hooks present at the posterior end: on the gills of marine fishes

Gastrocotyle v. Ben. et Hesse (Fig. 42)

c_2. Posterior region usually disk-like, without suckers, but with hooks . . . . Family V. Gyrodactylidae

d_1. Two or four short tentacle-like projections at anterior end of body; posterior disk with two large central hooks and numerous small marginal ones; worms minute: on skin and gills of fresh-water and marine fishes.

e_1. Two short anterior projections ; posterior disk with usually sixteen marginal hooks ; no eyes
Gyrodactylus v. Nordm. (Fig. 43)

e_2. Four short anterior projections ; posterior disk with usually fourteen marginal hooks ; four eyes
Dactylogyrus Dies. (Fig. 44)

d_2. No tentacle-like anterior projections.

e_1. A pair of anterior suckers present ; posterior end extended transversely, with four marginal hooks : on the gills of marine fishes
Diplectanum Dies. (Fig. 45)

e_2. No anterior suckers present.

f_1. Posterior region with four large central hooks.

g_1. Body contracted posteriorly ; posterior disk with a number (12–16) of small marginal hooks ; anterior end triangular, with four slight projections : usually on gills of fresh-water fishes . Tetraonchus Dies. (Fig. 46)

g_2. Body elongate ; posterior region trilobed, with twelve minute marginal hooks : on gills of Torpedo . Amphibdella Chatin (Fig. 47)

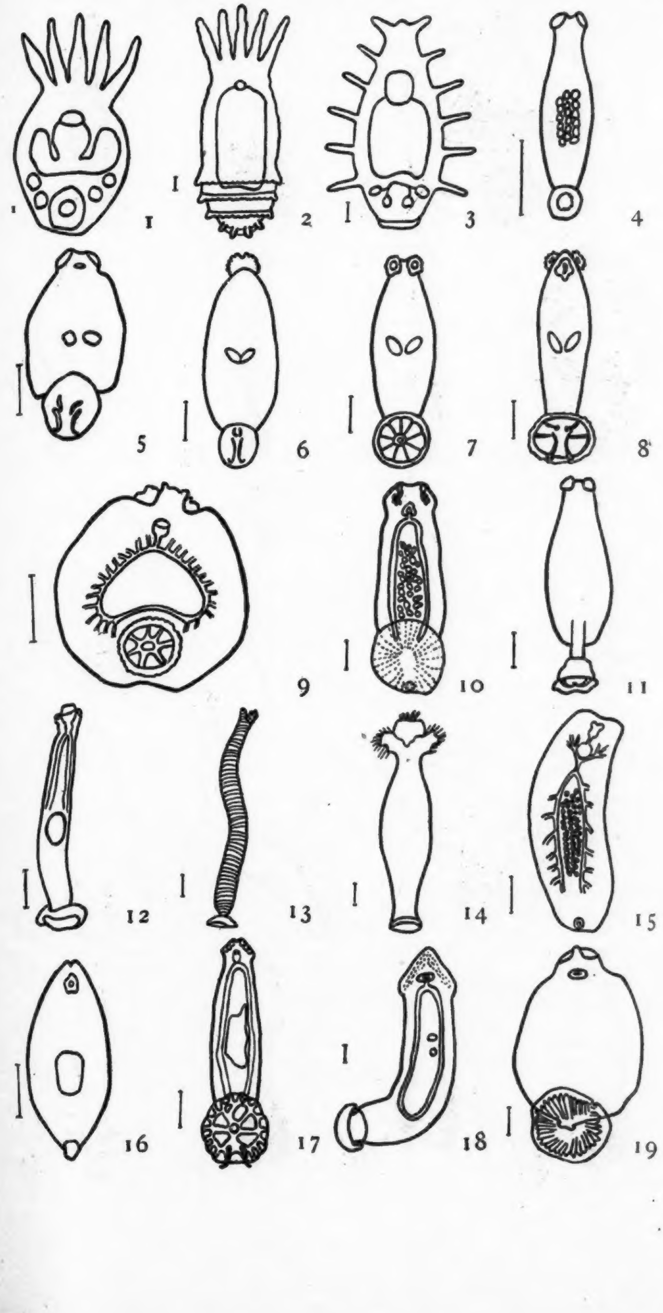
g_3. Posterior disk stalked, with lobed margin and no marginal hooks : on gills of Coregonus
Dactylodiscus Ols. (Fig. 48)

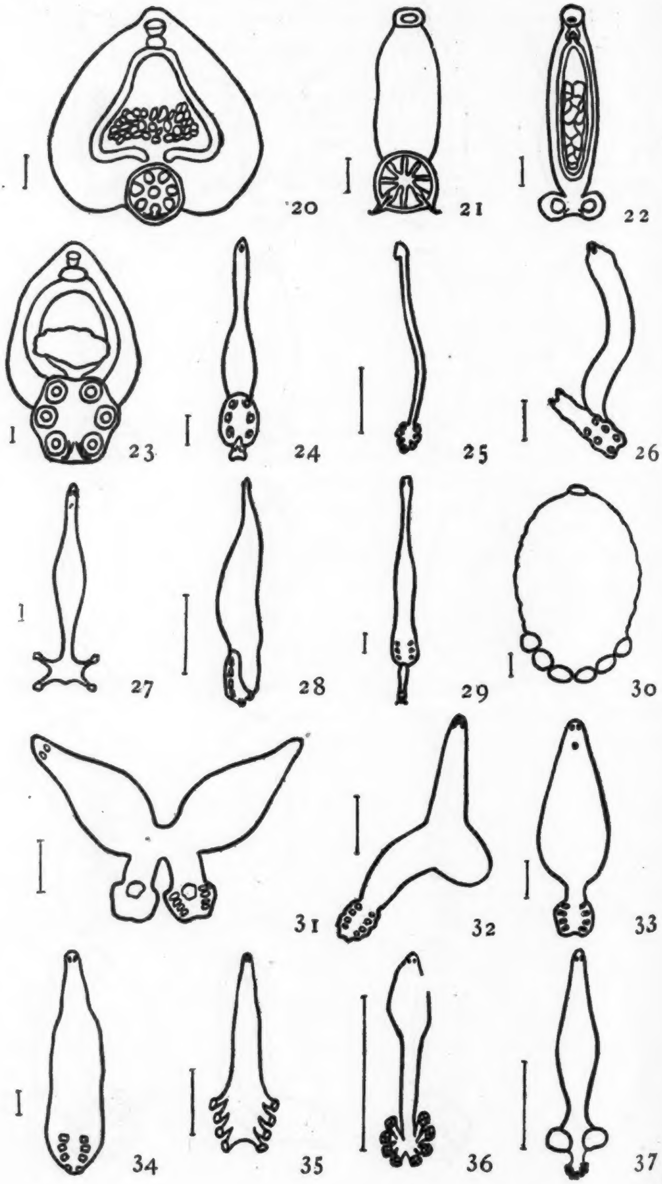
f_2. Posterior region with no large central hooks or with but one.

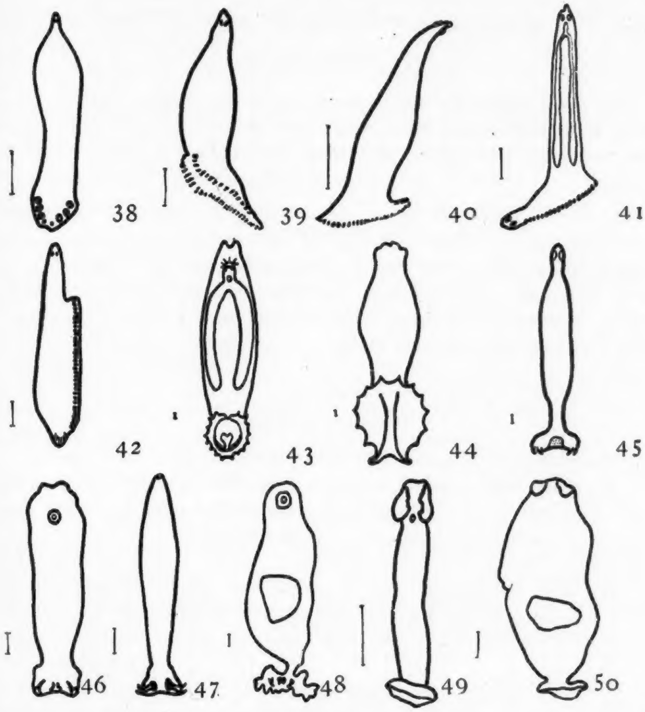
g_1. Broad, paired, membrane-like projection at anterior end ; posterior disk terminal, either unarmed, with minute hooks, or with a single large central hook ; body elongate, cylindrical : on gills of marine fishes
Calceostoma v. Ben. (Fig. 49)

g_2. A pair of glandular areas at anterior end ; posterior disk terminal, irregularly elliptical, with minute hooks in center ; a prominent glandular projection in middle of right side of body : on eggs of a fresh-water fish in Brazil . . Fridericianella Brds. (Fig. 50)

g_3. Two sucker-like depressions at anterior end ; posterior disk without hooks : on gills of Pagrus . . . . Anoplodiscus Sonsino.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19


20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37



The line to the left of the figures indicates the actual size of the animal. The measurements given in the keys, and upon which these lines are based, are usually maximum measurements. The softness and changeable form of the trematode make accurate measurements difficult.

(1) Temnocephala mexicana; (2) Craspedella spenceri; (3) Actinodactylella blanchardi; (4) Nitzschia elongata; (5) Epibdella bumpusii; (6) Phyllonella soleæ; (7) Trochopus tubiporus; (8) Placunella pini; (9) Tristoma coccineum; (10) Acanthocotyle verrilli; (11) Encotyllabe nordmanni; (12) Udonella caligorum; (13) Echinella hirundinis; (14) Pteronella molvæ; (15) Pseudocotyle squatinæ; (16) Microbothrium apiculatum; (17) Merizocotyle diaphanum; (18) Dionchus agassizi; (19) Lophocotyle cyclophora; (20) Calicotyle kroyeri; (21) Monocotyle myliobatis; (22) Sphyranura osleri; (23) Polystoma hassalli; (24) Erpocotyle lævis; (25) Diplobothrium armatum; (26) Onchocotyle canis; (27) Platycotyle gurnardi; (28) Pleurocotyle scombri; (29) Phyllocotyle gurnardi; (30) Plectanocotyle elliptica; (31) Diplozoön paradoxum; (32) Vallisia striata; (33) Octobothrium sagittatum; (34) Octocotyle scombri; (35) Dactylocotyle denticulatum; (36) Diclidophora affinis; (37) Anthocotyle merluccii; (38) Hexacotyle thunninæ; (39) Microcotyle longicauda; (40) Axine heterocerca; (41) Pseudaxine trachuri; (42) Gastrocotyle trachuri; (43) Gyrodactylus grœnlandicus; (44) Dactylogyrus auriculatus; (45) Diplectanum sciænæ; (46) Tetraonchus momenteron; (47) Amphibdella torpedinis; (48) Dactylodiscus borealis; (49) Calceostoma elegans; (50) Fridericianella ovicola.

KEY TO THE SPECIES OF NORTH-AMERICAN HETEROCOTYLEA.

GENUS TEMNOCEPHALA.

Body ovoid ; tentacles five in number, long and slender ; pharynx very large, intestine short but broad, with a pair of lateral anterior projections ; .5–1 mm. long, .2 mm. wide : on carapace of Cambarus Digueti (Mexico)
T. mexicana Vayssière (Fig. 1)

GENUS EPIBDELLA.

Body flat, smooth, ovate, slightly constricted behind the anterior suckers ; anterior suckers crossed by twenty-two ribs ; posterior sucker attached by pedicel at posterior margin of body, elliptical, with four hooks ; 12.5 mm. long, 8.35 mm. wide : on skin of *Dasyatis centura* (Woods Holl)
E. bumpusii Linton (Fig. 5)

GENUS TRISTOMA.

a_1. Diameter of sucking disk less than a third the length of the body.

- b_1. Body ovate ; sucking disk small, less than a quarter the length of body and but little larger than the anterior suckers ; 10 mm. long, 7 mm. wide : on gills of *Tetrapturus albidus*
T. cornutum Verrill
- b_2. Body heart-shaped ; color white, with small oval spots on the dorsal surface ; anterior end between the anterior suckers fringed ; 22.5 mm. long, 18 mm. wide : on the body of Diodon (California)
T. maculatum Rud.
- b_3. Body nearly circular, ventral periphery with short, radial rows of papillæ, and dorsal surface with several series of pointed black papillæ ; sucking disk with crenulate border, and not reaching the posterior end of body ; 15 mm. long, 12 mm. wide : on gills of sword fish (Woods Holl, Linton) . . *toccineum Cuv.* (Fig. 9)

a_2. Diameter of sucking disk equals one-third or half the length of body.

- b_1. Body circular, ventral surface covered with papillæ ; sucking disk large, its diameter equaling half the length of the body, and with a large central area ; 15 mm. long, 14 mm. wide : on gills of *Tetrapturus albidus* (Woods Holl, Linton) . *T. læve* Verrill
- b_2. Body almost circular, slightly attenuate forward ; sucking disk large, its diameter equaling one-third the length of body, and with a plicate membranous border ; 18 mm. long, 19 mm. wide : on *Mola mola* (Woods Holl, Linton) . . . . . . *T. molæ* Blanch.

GENUS NITZSCHIA.

a_1. Body lanceolate, reddish, contracted posteriorly ; sucking disk globose ; anterior suckers large, linear, oblique ; mouth triangular ; 16 mm.

long, 5 mm. wide; from gills and under the opercles of sturgeon (Woods Holl, Linton, etc.) . . . . *N. elongata* Nitzsch (Fig. 4)

a_2. Body linear, contracted posteriorly, very small; anterior portion papillose; sucking disk not globose; 1.9 mm. long, .5 mm. wide: from cod (Woods Holl) . . . . *N. papillosa* Linton

GENUS ACANTHOCOTYLE.

Body linear; anterior end blunt with a pair of glands and without anterior suckers; sucking disk large, circular, as wide as the body, with thirty-four radial rows of hooks; about thirty-seven testes; 5 mm. long, 1.2 mm. wide: on skin of skate (Cape Cod) . *A. verrilli* Goto (Fig. 10)

GENUS DIONCHUS.

Intestine bifurcate, distal ends fused; anterior end of body triangular, with two groups of glands; genital pore minute, on left side of ventral surface, near mouth; 2 mm. long, .5 mm. wide (Newport)
D. agassizi Goto (Fig. 18)

GENUS POLYSTOMA.

a_1. Posterior disk-like region attached to body between the two anterior pairs of suckers.

b_1. Body elongate, lanceolate; disk wider than body; three pairs minute hooks between anterior pair of suckers, one large and two small pairs between posterior pair of suckers; 6 mm. long: in the nose of the food terrapin . . . *P. coronatum* Leidy

b_2. Body broad, tapering forward; disk hexagonal; testis a large slightly lobed body in center of body; three pairs small hooks between anterior pair of suckers, and three pairs of small and one pair large hooks between posterior pair of suckers; intestine bifurcate, unbranched; 1.5 mm. long, 1 mm. wide: from urinary bladder of *Kinosternon pennsylvanicum*
P. hassalli, Goto (Fig. 23)

a_2. Posterior disk-like region, attached at its anterior end to body; body elliptical; intestine bifurcate, unbranched; penis provided with sixteen spines, alternately small and large; 2.5 mm. long, 1 mm. wide: in urinary bladder of musk turtle (*Aromochelys odoratus*)
P. oblongum R. R. Wr.

GENUS SPYRANURA.

Body elongate, contracted anteriorly and posteriorly just before disk, which is wider than body and bears two large suckers; intestine bifurcate, unbranched; testes numerous; 4 mm. long, .6 mm. wide: on skin of Necturus . . . . *S. osleri* R. R. Wr. (Fig. 22)

GENUS OCTOBOTHRIUM.

Body sagittate, tapering anteriorly; posterior suckers on a distinct disk which is not so wide as the body; 6 mm. long, 2 mm. wide: on gills of *Castastomus teres* (R. R. Wright) *O. sagittatum* F. S. Leuck.[1] (Fig. 33)

GENUS OCTOCOTYLE.

Body elongate, lanceolate; anterior suckers elongate, posterior suckers small, slightly stalked, in two rows; genital pore with two longitudinal rows of six (five) small hooks each; two pairs of hooks between posterior pair of suckers; 5 mm. long, .6 mm. broad: on gills of mackerel (Newport, Goto) . . . . *O. scombri* Kuhn (Fig. 34)

GENUS DACTYLOCOTYLE.

Body lanceolate; anterior portion of each posterior sucker with numerous denticulate papillæ; 8 mm. long, 2 mm. wide: on gills of the pollack (Woods Holl, Linton) . . . . *D. denticulatum* Ols. (Fig. 35)

GENUS DICLIDOPHORA.

Body elongate, spatulate, anterior portion elliptical, posterior portion cylindrical; posterior suckers on long stalks; cirrus armed with fifteen bifurcate hooks; 12–40 mm. long: from the mouth of flounder (Woods Holl) . . . . *D. offinis* Linton (Fig. 36)

GENUS MICROCOTYLE.

a_1. Testes not numerous, twelve to fifteen in number, median in hinder part of body.

- b_1. Testes about twelve in number, in front of which is ovary; length of sucker-bearing region about one-third that of body, with about forty-six pairs of suckers; 2.5 mm. long, .6 mm. wide: on gills of Scup (Newport) . . . . *M. stenotomi* Goto
- b_2. Testes about fifteen in number, in front of which is ovary; length of sucker-bearing region about one-fourth that of body, with about twenty-three pairs of suckers; 2.5 mm. long, 6 mm. wide: on gills of blackfish (Newport) . . . . . *M. hiatulæ* Goto

a_2. Testes numerous, fifty to fifty-five in number, median in hinder part of body.

- b_1. Testes about fifty in number, in front of which is ovary; length of sucker-bearing region about one-third that of body, with about seventy pairs of suckers; 4 mm. long, 1 mm. wide: on gills of bluefish (Newport) . . . . *M. pomatomi* Goto

[1] The systematic position of this species is uncertain.

b_2. Testes about fifty-five in number, in front of which is ovary ; length of sucker-bearing region about seven-elevenths that of body, with about 120 pairs of suckers ; 7 mm. long, 2 mm. wide : on gills of weakfish (Newport) . *M. longicauda* Goto (Fig. 39)

Genus Gyrodactylus.

Body elongate, elliptical, mouth surrounded by a row of spines ; posterior disk round ; the large central hooks have each double tubercles on its base ; 1 mm. long, .2 mm. wide : on *Cottus scorpius*
G. grœnlandicus Lev. (Fig. 43)

Genus Plectanocotyle.

Body elliptical, broad ; mouth terminal ; no median posterior projection or hooks ; 4 mm. long, 2 mm. wide : on gills of *Rocus americanus*
P. elliptica Dies. (Fig. 30)

SELECTED BIBLIOGRAPHY.

'94 Brandis, G. Fridericianella ovicola, ein neuer monogenetischer Trematod. *Abh. d. Naturforschenden Ges. zu Halle.* Bd. xx, pp. 303–310, Taf. XIX.

'92, '93 Braun, M. Plathelminthes : I. Trematodes. Bronn's *Klassen u. Ordnungen d. Thierreichs.* Bd. iv, pp. 306–924, Taf. I–XXXIV. (A complete bibliographical list will be found here.)

'96 ——. Hamburger Magalhaensische Sammelreise.

'95 Cerfontaine, P. Contribution à l'étude des octocotylidés. *Archives de Biologie.* T. xiv, pp. 497–560, Pls. XXII–XXV.

'97 ——. Le genre merizocotyle (Cerf.) *Archives de Biologie.* T. xv, pp. 329–366, Pls. XIII, XIV.

'97 ——. Contribution à l'étude des octocotylidés. *Archives de Biologie.* T. xv, pp. 301–328, Pl. XII.

'99 ——. Contribution à l'étude des octocotylidés. *Archives de Biologie.* T. xvi, pp. 345–478, Pls. XVIII–XXI.

'94 Goto, S. Studies on the Ectoparasitic Trematodes of Japan. *Journ. Sci. Coll., Imp. Univ.* Vol. viii, Pt. i, pp. 1–273, Pls. I–XXVII.

'99 ——. Notes on Some Exotic Species of Ectoparasitic Trematodes. *Journ. Sci. Coll., Imp. Univ.* Vol. xii, Pt. iv, pp. 263–295, Pls. XX–XXI.

'88 Leidy, J. Entozoa of the Terrapin. *Proc. Acad. Nat. Sci. Philadelphia*, pp. 126, 127.

'98 LINTON, E. Notes on Trematode Parasites of Fishes. *Proc. U. S. Nat. Mus.* Vol. xx, pp. 507–548, Pls. XL–LIV.

1900 ——. Fish Parasites collected at Woods Holl in 1898. *Bull. U. S. Fish Commission.* Pp. 287–304, Pls. XXVIII–XXXVIII. 1899.

'92 MONTICELLI, F. S. Cotylogaster michaelis *n. g., n. sp. Festschrift zum siebenzigsten Geburtstage Rudolf Leuckarts.* pp. 168–214, Taf. XXI, XXII.

'99 ——. Di una nuova specie del genere Plectanocotyle. *Atti d. Accad. Reale d. Sci. di Torino.* Vol. xxxiv, pp. 3–11, con una tavola.

'99 ——. Il genere Acanthocotyle. *Arch. d. Parasit.* Vol. ii, pp. 75–120, Tav. I–III.

'99 ——. Sulla Temnocephala brevicornis Mont. (1889) e sulle temnocefale in generale. *Boll. d. Soc. d. Nat. in Napoli.* Vol. xii, pp. 72–127, Tav. III, IV.

'91, '92 SAINT-REMY, G. Synopsis des trématodes monogénèses. *Rev. Biol. d. Nord. d. l. France.* 3e Ann., pp. 405–416, 449–457; 4e Ann., pp. 1–21, 90–107, 136–145, 186–191, 253–265, Pl. X.

'98 ——. Complément du synopsis des trématodes monogénèses. *Arch. d. Parasit.* Vol. i, pp. 521–571.

'94 STILES, C. W., AND HASSALL, A. A Preliminary Catalogue of the Parasites contained in the Collections of the United States Bureau of Animal Industry, United States Army Medical Museum, Biological Department of the University of Pennsylvania (Coll. Leidy), and in Coll. Stiles and Coll. Hassall. *Veterinary Magazine.* April, 1894, pp. 245–253; and May, 1894, pp. 331–354.

'98 VAYSSIÈRE, A. Description du Temnocephala mexicana, *nov. sp. Ann. Fac. Scien. Marseille.* T. viii, fas. 10, pp. 17–25, Pl. XI.

'75 VERRILL, A. E. Brief Contributions from the Museum of Yale College, No. 33. *Amer. Journ. of Sci. and Arts.* Vol. x.

'85 ——. Results of the Exploration made by the steamer *Albatross* of the North coast of the United States in 1883. *Annual Report of the Commission of Fish and Fisheries for 1883.* Pl. XLIII, Figs. 183, 194.

'79 WRIGHT, R. RAMSEY. Contributions to American Helminthology. *Proc. Can. Inst.* Vol. i, N. S., pp. 54–75, Pls. I, II.

'87 WRIGHT, R. R., AND MACALLUM, A. B. Sphyranura osleri: A Contribution to American Helminthology. *Journ. of Morph.* Vol. i, pp. 1–48, Pl. I.

REVIEWS OF RECENT LITERATURE.

ZOÖLOGY.

Garman's Deep-Sea Fishes. — The most important work in ichthyology for the past year is Mr. Samuel Garman's monumental report on the deep-sea fishes collected off the western equatorial coasts of America and off the Galapagos Islands. It is based on the specimens obtained by the steamer *Albatross* in the winter of 1891, while under the direction of Professor Alexander Agassiz. This report contains an annotated list of the species obtained, 176 of them new to science, together with a supplementary volume of plates, in which most of the species are beautifully figured. The general report is preceded by a valuable discussion of the distribution of the deep-sea fishes, and it is followed by an anatomical paper on the lateral line in fishes, its function and significance.

The species added to the fauna of Middle America are the following:

Raja badia.
Raja alia (Yucatan = *R. achleyi* G. and B., not Garman).
Centroscyllium nigrum.
Isistius (rather *Leius*) *brasiliensis* (Q. and G.).
Liopropoma longilepis.
Centristhmus signifer (new genus allied to Anthias).
Pontinus furcirhinus.
Ectreposebastes imus (new genus allied to Scorpæna).
Hoplostethus pacificus.
Trachichthys mento.
Caulolepis subulidens.
Melamphaës mizolepis (Günther).
Melamphaës (*Plectromus*) *nigrofulvus.*
Melamphaës maxillaris.
Melamphaës frontosus.
Gempylus thyrsitoides (Lesson) (= *G. serpens* C. and V.).
Trichiurus nitens.
Teuthis elegans.
Chiasmodon subniger.
Lophiomus spilurus.
Lophiomus caulinaris (*L. setigerus* Gilbert; Jordan and Evermann; not of Wahl — a Japanese species).
Dolopichthys allector (new genus, near Ceratias).
Chaunax coloratus (type of subgenus Chaunacops).
Oncocephalus porrectus.
Halieutopsis tumifrons (new genus, near Halieutæa).
Dibranchus hystrix.
Dibranchus scaber.
Dibranchus asper.
Dibranchopsis (new genus for *Halieutæa spongiosa* Gilbert).
Dibranchichthys nudivomer.
Malthopsis sparsa.
Malthopsis erinacea.

Malthopsis spinosa.
Malthopsis spinulosa.
Prionotus frontalis.
Peristedium barbigerum.
Peristedium crustosum.
Careproctus longifilis (Garman, 1892).
Paraliparis fimbriatus (Garman, 1892).
Paraliparis grandiceps.
Paraliparis attenuatus.
Paraliparis angustifrons.
Paraliparis latifrons.
Callionymus atrilabiatus.
Entomacrodus cruentatus.
Bothrocaropsis alalonga (new genus, near Maynea).
Bothrocaropsis rictolata.
Bothrocaropsis elongata.
Gymnelis conorhynchus.
Lycodopsis scaurus.
Lycodes anguis.
Lycodes serpens.
Lycodes incisus.
Lycodes cicatrifer.
Phucocœtes suspectus.
Maynea bulbiceps.
Leucicorus lusciosus (new genus of Brotulidæ).
Mixonus caudalis.
Dicrolene filamentosa.
Dicrolene nigra.
Dicrolene pullata.
Porogadus longiceps.
Porogadus atripectus.
Porogadus breviceps.
Monomitopus torvus.
Monomeropus malispinosus.
Bassozetus nasus.
Diplacanthopoma jordani.
Holcomycteronus digitatus (new genus of Brotulidæ).
Eretmichthys pinnatus (new genus of Brotulidæ).
Eretmichthys ocella.
Catætyx simus.
Pseudonus acutus (new genus of Brotulidæ).
Acanthonus spinifer.
Sciadonus pedicellaris (new genus of Brotulidæ).
Lamprogrammus illustris.
Microlepidium grandiceps (new genus, near Lepidion).
Leptophycis filifer (new genus, near Lepidion).
Merluccius angustimanus.
Antimora rhina.
Læmonema gracilipes.
Phyciculus longipes.
Bregmaceros longipes.
Macrurus bulbiceps.
Macrurus bucephalus.
Macrurus liraticeps.
Macrurus barbiger.
Macrurus capito.
Macrurus leucophæus.
Macrurus boops.
Macrurus fragilis.
Macrurus carminifer.
Macrurus gracilicauda.
Macrurus orbitalis.
Macrurus loricatus.
Macrurus cuspidatus.
Macrurus convergens.
Macrurus latirostratus.
Macrurus anguliceps.
Macrurus latinasutus.
Macrurus trichiurus.
Macrurus tenuicauda.
Macrurus canus.
Hippoglossina vagrans.
Citharichthys maculifer.
Monolene maculipinna.
Monolene dubiosa.
Symphurus varius.
Symphurus microlepis.
Sternoptyx obscura.
Argyropelecus lychnus.
Argyropelecus caninus.

Argyropelecus affinis (= *A. hemigymnus* G. and B., not type).
Polyipnus laternatus (from Barbados = *P. spinosus* G. and B., not type).
Valenciennellus stellatus.
Maurolicus oculatus.
Maurolicus lucetius.
Lychnopoles argenteolus (new genus, near Gonostoma).
Cyclothone signata.
Cyclothone acclinidens.
Synodus simulans.
Synodus acutus.
Chlorophthalmus mento.
Scopelengys dispar.
Bathypterois ventralis.
Bathypterois pectoralis.
Ipnops agassizii.
Myctophum oculeum.
Myctophum tenuiculum.
Myctophum luminosum.
Myctophum aurolaternatum.
Myctophum nitidulum.
Myctophum laternatum.
Myctophum atratum.
Chauliodus barbatus.
Chauliodus dentatus.
Stomias colubrinus.
Stomias hexagonatus.
Stomias atriventer.
Dactylostomias filifer (new genus, near Stomias).
Leptochilichthys agassizii (new genus, near Alepocephalus).
Bathytroctes alvifrons.
Bathytroctes alveatus.
Bathytroctes inspector.
Narcetes pluriserialis.
Alepocephalus asperifrons.
Alepocephalus convexifrons.
Alepocephalus fundulus.
Halosaurus attenuatus.
Halosaurus radiatus.
Notacanthus spinosus.
Uroconger varidens.
Congermuræna (*Congrellus*) *caudalis.*
Congrosoma evermannii.
Ophichthys (*Cryptopterus*) *frontalis.*
Ophichthys biserialis.
Echidna cocosa.
Echidna scabra.
Xenomystax rictus.
Chlopsis gilbertii.
Venefica ocella.
Venefica tentaculata.
Serrivomer sector.
Labichthys bowersii.
Nemichthys fronto.
Atopichthys esunculus (group name for larval eels, of unknown relations).
Atopichthys sicarius.
Atopichthys cinctus.
Atopichthys dentatus.
Atopichthys falcidens.
Atopichthys acus.
Atopichthys ophichthys.
Atopichthys cingulus.
Atopichthys lychnus.
Atopichthys obtusus.
Atopichthys longidens.
Myxine circifrons.
Myxine acutifrons.

Mr. Garman shows that the name "Homea, Fleming" is prior to both Heptatrema (Voigt, 1832) and Bdellostoma (Müller, 1834). It should, therefore, take the place of both of these. It may be also noted (p. 223) that, in the original description of Engyophrys, Jordan and Bollman, "cycloid" was a slip of the pen for "ctenoid."

Mr. Garman completes his work with a most useful list of the

deep-sea fishes of the world, with a table showing their distribution. A full bibliography and a number of other useful tables are also included.

D. S. J.

Jenkins on Labroid Fishes of Hawaii. — In the *Bulletin of the United States Fish Commission* Dr. Oliver Peebles Jenkins, of Stanford University, gives an account of new species of labroid fishes obtained by him and by others in Honolulu in 1889 and later. The chief collection was made by Dr. Jenkins and his assistant, Dr. George C. Price, under the auspices of De Pauw University. Later, both Dr. Jenkins and Dr. Price were called to Stanford University, and the original collection of fishes, by far the largest yet made about the Hawaiian Islands, was supplemented by others, the principal one being made by Dr. Thomas D. Wood, also of Stanford University.

In the single group of Labridæ and Scaridæ twenty-two new species were obtained. These are described and figured in the present paper. These new species are the following:

Macropharyngodon aquilolo.
Halichœres iridescens.
Halichœres lao.
Hemicoris remedius.
Coris lepomis.
Hemicoris keleipionis.
Thalassoma pyrrhovinctum.
Novaculichthys woodi.
Novaculichthys entargyreus.
Hemipteronotus umbulatus.
Iniistius leucozonus.
Iniistius verater.
Cheilinus zonurus.
Pseudocheilinus octotænia.
Anampses evermanni.
Calotomus irradians.
Scarus brunneus.
Scarus gilberti.
Scarus paluca.
Scarus ahula.
Scarus miniatus.
Pseudoscarus jordani.

This list indicates the extreme richness of the Hawaiian fish fauna, its isolation and distinctness as compared with the fauna of the East Indies, and the fact that the few collections yet made about Honolulu have barely touched the wealth of the whole.

D. S. J.

Greene on the Caudal Heart of the Hagfish. — In the *American Journal of Physiology* Dr. Charles Wilson Greene gives his studies on the caudal heart in the California hagfish, *Polistotrema stouti.* This structure was first discovered by Retzius in 1890, who accidentally noticed a paired pulsating organ in the tail of the slime eel (Myxine). The function of this structure is to drive the blood of the subcutaneous spaces back into the circulatory system.

We are pleased that Dr. Greene calls this curious animal by its

actual scientific name. Bdellostoma, like Amphioxus, has its place in the history of anatomy, but neither of these terms is the scientific name of anything, any more than lancelet is, or hag. Branchiostoma is the scientific name of the chief genus of lancelets.

Homea is the name of this group of hagfishes, Heptatrema and Bdellostoma being later synonyms of the same, with no standing in scientific nomenclature. For the species of Homea, with an increased number of gill openings, Dr. Gill has proposed the name of "Polistotrema." There are two species of Polistotrema, *P. dombey* of Chili and *P. stouti* of California. These are not very much unlike and may be really the same thing, though the balance of evidence at present favors their distinction as species. If one does not recognize the genus Polistotrema, the California hagfish, which is rapidly taking its place among the anatomical classics, must be *Homea stouti.*

D. S. J.

Jordan and Snyder on Fishes of Mexico.— In the winter of 1899–1900 Messrs. Jordan and Snyder made a large collection of fishes in the fresh waters of Mexico, especially about Guadalajara, Mexico, Aguas Calientes, Puente de Ixtla, San Luis Potosi, and Tampico. Forty species were taken, twenty of them being new to science, and four new genera, Istlarius (Siluridæ), Xystrosus, Falcula (Cyprinidæ), and Xenendum (Pœciliidæ).

The collection indicates that the river fauna of Central Mexico is far more abundant and characteristic than had been hitherto supposed. A most unexpected fact was the large number of very closely related species of Pescado del Rey, or Pescados Blancos, found in the great lake of Chapala. All are alike excellent as food, rich and delicate in flavor. The new species are all figured. These are the following:

Istlarius balsanus, a large catfish from Rio Ixtla, south of the volcanoes in Morelos.
Notropis rasconis, Rio Verde (Rascon), near San Luis Potosi.
Notropis calientes, Rio Verde de las Aguas Calientes.
Xystrosus popoche, Lake Chapala.
Falcula chapalæ, Lake Chapala.
Characodon encaustus, Lake Chapala.
Xenendum caliente, Aguas Calientes.

The genus Xenendum is allied to Goodea, but with bifurcate teeth, which, as in Goodea, are loosely attached. The intestines are very long, as in Pœcilia, but the sexes are similar.

Xenendum xaliscone, Lake Chapala.

Pœcilia limantouri, Rio Ixtla, Tampico, and Rascon.

Xiphophorus montezumæ, Rascon.

Eslopsarum arge, Aguas Calientes. *Chirostoma breve* Steindachner is an Eslopsarum and identical with the earlier named *E. jordani.*

Chirostoma chapalæ.

Chirostoma crystallinum.

Chirostoma lermæ; this species has been recently described by Dr. Boulenger as *C. sphyræna*, also from Lake Chapala specimens. Dr. Boulenger's name takes precedence.

Chirostoma diazi; this is *C. lucius* Boulenger, a prior name.

Chirostoma ocotlane.

Chirostoma promelas. All these species of Chirostoma are from Lake Chapala, near Ocotlan in Jalisco.

Xeros istlanus, Puente de Ixtla.

Neetroplus carpintes, Lake Carpinte, Tampico.

Cichlasoma steindachneri, Rascon. D. S. J.

Notes on Recent Fish Literature. — Dr. Louis Dollo, of Brussels, describes a new genus of trachinoid fishes collected by M. E.-G. Racovitza, naturalist of the Belgian Antarctic Commission. To it he applies the name of *Cryodraco antarcticus.* The type came from a depth of 450 meters, in the Antarctic Ocean (Lat. 71° 22′ S., Long. 88° 38′ W.).

Mr. Edgar W. Waite gives an account of an "oarfish," or "king of the herrings" (*Regalecus glesne ?*), taken near Port Jackson in Australia. The species of this rare and interesting deep-water genus have not been adequately determined, and Mr. Waite's paper will prove valuable for future comparisons.

In the *Anales del Museo Nacional de Buenos Aires* Dr. Carlos Berg publishes valuable notes on various fishes — Exomegas, Polyprion, Curimata, Ilisha, Crenicichla, etc. He shows that the name *Ilisha orbignyana* should replace that of *Ilisha flavipinnis,* adopted by Jordan and Evermann. The identity of *Cottoperca rosenbergi* with *Aphritis gobio* is also shown, the species standing as *Cottoperca gobio.*

Dr. L. Berg, of the University of Moscow, has published in the *Proceedings of the Caucasian Museum* at Tiflis an account, in Russian and in German, of the fishes collected by Dr. G. Radde, director of the museum at Tiflis. Thirty-one species are included, one of them being regarded as a new "variety."

In the *Transactions of the London Zoölogical Society* Dr. Boulenger gives a second account of the rich fish fauna of Lake Tanganyika, from the collections of the Lemaire Expedition. A number of new genera and species of Cichlidæ are described and well figured, three of the plates being in colors, the work of the artist of the expedition, M. Dardenne.

In the *Proceedings of the Scientific Society of Christiania* Dr. Robert Collett discusses in detail the relations of *Lycodes gracilis*, a fish of the arctic parts of the Atlantic. Several figures are given, together with detailed description. Dr. Collett regards *L. perspicillum* as probably the young of *L. reticulatus*, *L. rossi* as probably the very young of *L. pallidus*, and *L. zoarchus*, from Nova Scotia, as certainly the young of *L. gracilis*. These conclusions differ somewhat from those of Dr. Smith, noted a few months since.

The species of filefish described by Jordan and McGregor from Clarion Island, Mexico, under the name of *Cantherines carolæ*, proves to be identical with the type of Cantherines, *C. sandwichiensis* Quay and Gaimard of Hawaii, a fact first pointed out by Mr. R. E. Snodgrass. It is not evident that either *C. pullus* of the West Indies, or *C. pardalis* of the East Indies, is really different from *C. sandwichiensis*.

In a private letter Professor D'Arcy W. Thompson, of University College, Dundee, corrects the current account of the genus Eumesogrammus. The type *E. præcisus* has four lateral lines, not three, the fourth being a ventral branch, accessory to the third, and running from the breast to near the vent. This was correctly described by Dr. Reinhardt, but overlooked by later authors.

In a recent note in the *Naturalist* on Dr. Charles Wilson Greene's studies of the California toadfish, or "midshipman" (*Porichthys notatus*), the writer, by a slip of the pen, made a statement just the opposite of the truth.

The fish showed no luminosity, save when excited by electricity or by ammonia. In an aquarium made alkaline by ammonia water all the spots and organs of the lateral line gave out a brilliant glow, fading away in about twenty minutes. Parts of the fish, after death, were luminous under ammonia. A similar effect was shown by severe electric stimulations, but a mild current produced no effect.

D. S. J.

Compensatory Movements of the Eyes in Fishes.—It is well known that when a dogfish is rotated on its long axis its eyes are

turned so as to compensate in a measure for the abnormal position in which the fish is placed. Lee showed that these compensatory movements may be called forth by stimulating the sense organs of the semicircular canals in a quiet dogfish resting in a normal position, and he therefore believed that the normal compensatory movements of the eye were reflexes produced by a stimulation of the organs of the semicircular canals. E. P. Lyon[1] has made the interesting discovery that certain eye movements can be produced without the intervention of the semicircular canals. If the tail of a dogfish is turned to one side, the eye of the same side is directed forward, that of the opposite side, backward. As this experiment succeeds after the eighth nerves are cut, it follows that this reflex is not to be regarded as originating in the ear. Moreover, when the spinal cord is divided well forward in the body, the reflex ceases, and the author, therefore, rightly concludes that the sensory disturbances, which give rise to the reflex, are located in the posterior part of the trunk and make their way forward through the cord. The author finally calls attention to the uncertainty of compensatory movements of the eye as evidence of stimulation of the organs in the semicircular canals.

P.

Development of Lepidosiren. — The development of this rare and interesting fish is being worked out by J. Graham Kerr,[2] whose first paper on the subject gives an account of the way in which eggs may be obtained and the external features of their development. The eggs are laid in underground burrows in swamps. The fertilized egg as taken from the nest is enclosed in a thin, horny capsule, round which is occasionally a jelly-like envelope. Segmentation is complete and unequal, as in Amia. The gastrula closely resembles that of Petromyzon. The medullary folds are low, and the neural axis arises mainly as a solid down-growth. There is no neurenteric canal. Four external gills are developed upon branchial arches, I, II, III, and IV. Auditory and nasal sacs and stomodæum are formed by secondary excavation of originally solid rudiments. The young fish, which at hatching is tadpole-like, remains two weeks without developing pigment, after which the retinal pigment begins

[1] Lyon, E. P. Compensatory Motions in Fishes, *Amer. Journ. of Phys.*, vol. iv (1900), pp. 77–82.

[2] Kerr, J. Graham. The External Features in the Development of Lepidosiren paradoxa Fitz, *Phil. Trans. Roy. Soc. London*, Ser. B, vol. cxcii (1900), pp. 299–330, Pls. VIII–XII.

to appear. The fore and hind limbs suffer rotation, so that the resultant upper surface of either is homologous with the lower surface of the other, as in Ceratodus. Pulmonary breathing begins before the external gills show signs of degeneration. About six weeks after hatching, the external gills are lost. The young Lepidosiren is remarkably newt-like in its general appearance and uses its hind limbs in clambering about the vegetation. It also has some powers of change of color by the action of its chromatophores. P.

Multiplication of Nuclei in Transversely Striped Muscle Fibres of Vertebrates.[1] — Godelewski's work, of which he gives a preliminary account, was carried on at the Anatomical Institute of the Jagellonian University at Krakow. The material was from late embryos and recently born young ot the guinea pig and mouse, and from larvæ of Salamandra. To avoid undue contraction of the muscles the whole extremity was employed; it was fixed in Perenyi's fluid or in concentrated sublimate solution plus 2 per cent acetic acid. The sections, 5 μ thick, were stained either in thionin or in Heidenhain's iron-hæmatoxylin, followed by Bordeaux R or eosin.

In the quiescent nuclei of embryonic or larval muscle cells the chromatin constitutes a thin layer at the periphery of the nucleus, which contrasts sharply by its blue color with the single brilliant red nucleolus. That the nuclei are highly elastic is shown by the flattened forms they assume in muscles that have strongly contracted owing to their being cut away from their attachments to bone before fixing.

Nuclear reproduction takes place both by the mitotic and by the amitotic process. The author has observed all stages of mitosis in muscle fibres that were already distinctly striped, not only in the deep nuclei, but also in those that had already attained a peripheral position. The approaching division is indicated by an increase both in the size of the nucleus and in the distinctness of the chromatic network. The nucleolus disappears. The fibrillæ next the nucleus separate a little from each other, and a clear fluid plasma accumulates around the nucleus. If this is a marginal nucleus, it protrudes with its enveloping plasma beyond the surface of the fibre.

Special attention was directed to the question of the presence of centrosomes. Though previous observers have never announced the existence of centrosomes in differentiated transversely striped muscle

[1] Godelewski, E., Jr. Ueber die Vermehrung in den quergestreiften Muskelfasern der Wirbelthiere, *Bull. de l'Acad. des Sciences de Cracovie.* Avril, 1900.

tissue, the author found them in typical form, not only in the monaster stage, but even as early as the spireme stage. In the former the central corpuscle, stained black in iron-hæmatoxylin, was surrounded by a typical polar star. Also in the diaster stage the centrosomes continue to be evident; the axis of the central spindle is at first straight, but later may become bent; the interzonal filaments, with their equatorial thickenings, become pressed together to form the deeply staining "Zwischenkörper," which here, as in other cases, is not dependent on the formation of a cell wall. In the [cup-shaped] depression of the nuclei of the diaster stage a remnant of the centrosome and the achromatic cone fibres is still visible, and after the formation of a nuclear membrane around the two masses of chromatin, establishing the two daughter-nuclei, traces of the "Zwischenkörper" and central spindle are still to be seen.

During karyokinesis the surrounding protoplasm acquires a granular appearance. The granules, which are deeply stained in iron-hæmatoxylin, appear in the monaster stage; in the diaster stage and the following anaphase these increase in number, so that the mitotic figure is surrounded by coarsely granular protoplasm.

In addition to the karyokinetic, there is also an amitotic nuclear division, and while in general it may be said that the latter method replaces the former, the author is unable to say just when the one ceases or the other begins. Both processes are, indeed, to be seen in older embryos at the same time and in the same muscle. The first indication of the non-mitotic division is to be seen in the nucleoli, of which there are at first one or two to each nucleus. The nucleolus elongates, becomes narrower in the middle, at length dumb-bell-shaped, and finally divided; the two nucleoli then move apart. This process may be repeated. The chromatic substance meanwhile becomes collected into lumps of irregular form, which are, however, uniformly distributed through the nucleus.

The actual division of the nucleus may take place in one or the other of two ways: First, by the formation of a thin, flat partition, which is perpendicular to the axis of the elongated nucleus or, often, oblique to it. Sometimes only a single partition is formed, but often the nucleus is divided by such partitions into as many as six, or even more, portions — the new or daughter nuclei; secondly, by the formation of invaginations from [*i.e.*, constrictions of] the periphery of the nucleus this very much elongated body is finally divided into two, or sometimes several, not always equal, parts, each of which contains a single nucleolus or, less often, two. The daughter-nuclei

separate from each other, but occasionally they remain connected by a bridge of substance, and in some cases this is elongated, so that when several daughter-nuclei in succession are thus joined they resemble a rosary.

Both forms of fragmentation may occur side by side in the same muscle, and even in the same nucleus. Besides these nearly transverse divisions, a longitudinal splitting of the nucleus is sometimes met with.

H.

Are the Solpugids Poisonous? — It has long been a disputed question as to whether the arachnids known as Solpugids are poisonous or not. In the regions where they occur they have a very bad reputation; but naturalists who have studied their structure have never found poison glands or ducts. Recently Lönnberg[1] has described his observations on *Galeodes araneoides* in the neighborhood of Baku, on the Caspian. He found that the "falanger," as the Russians call it, did not poison insects and other animals upon which it preyed. In attacking a small scorpion it crushed one of the slender joints of the abdomen and then the segment containing the poison sac. It next attacked the larger abdominal segments, working its jaws into the interior and devouring the flesh. During this whole time the scorpion struggled and fought, moving freely and showing no sign of being poisoned. It could not penetrate the skin of a frog, although it attempted to bite it several times. Finally Lönnberg and a friend both allowed the Galeodes to attempt to bite them; but its jaws were not strong enough to penetrate the thickened skin of the finger tips, while flies which were bitten, but which did not have the nervous system injured, were able to crawl around a long time after being bitten. These facts, together with the absence of openings in the chelæ through which poison could escape, led Lönnberg to the conclusion that Galeodes at least is not venomous. At the time for hibernation it dug into the ground, using the two anterior pairs of legs, but where the earth was harder it used the chelæ to remove small stones and bits of clay.

New Jersey Insects. — Professor J. B. Smith's list of the insects occurring in New Jersey is issued as a Supplement to the *27th Annual Report of the State Board of Agriculture* and may be considered a revised and enlarged edition of the one published in 1890 by the Geological Survey of New Jersey. It makes a volume of more than

[1] *Ofversigt k. Vet. Akad. Forhandl. Stockholm*, Bd. lvi (1900), p. 977.

750 pages, with 328 cuts and two maps; one of the maps shows the locations of the colonies of the San José scale, and the other is the 1896 relief map of the State Geological Survey. The list proper is preceded by short chapters dealing with the development of insects, their injuries, insecticides, and machinery.

According to the summary given on page 701, Professor Smith's first list contained 238 families, 2307 genera, and 6098 species; in the volume under consideration 329 families, 3181 genera, and 8537 species are recorded. The increase in the number of families is apparent rather than real, as it is due to a more minute division than was deemed advisable in the earlier volume. As instances it may be noted that the bees listed in 1890 in two families are now given in fourteen, and the sawflies included in the Tenthredinidæ in 1890 are now divided into ten families.

The list, though a useful and interesting one, would have greater scientific value had Professor Smith followed Dr. Calvert's practice, in the Odonata, of including only those species of which he had seen specimens actually collected in the state, or for which the best authority could be cited. The records, "New Jersey probably," "should occur in New Jersey," "will probably occur in New Jersey," are frequent, and in some instances such statements include the data given for all the species of a family. H.

Mating Instinct in Moths. — A. G. Mayer[1] carried 449 cocoons of *Callosamia promethea* from Cambridge, Mass., to Loggerhead Key, off the Florida coast. When the moths emerged they were many hundred miles south of the southernmost range of this species. Experiments were then made on the way in which the females attract the males. Males do not come to females in hermetically sealed glass boxes, but they do congregate about boxes which do not admit of a sight of the female, but which allow odors from the female to escape to the outer air. Males will seek out such boxes even when the vapor of carbon bisulphide or of ethyl mercaptan is escaping from the box, together with such odorous material as the female may produce. The sense organs of the males stimulated by these substances are the antennæ, for when these organs are covered with shellac, glue, or other impervious materials, the males no longer seek the females. Females thirty to sixty hours old are much more attractive to males than young females five to ten hours old. Virgin

[1] Mayer, A. G. On the Mating Instinct in Moths, *Psyche*, vol. ix (1900), pp. 15–20.

females are somewhat more attractive than are fertilized ones of the same age. If the eyes of a male are covered with Brunswick black so as to prevent sight, the male will still mate in a normal way if placed near a female. If the wings of a female, which are of a reddish-blue, are cut off, and the wings of a male, which are darker, are glued to the stumps of the wings on the female, the female insect can be made to look much like the male, and yet males will mate normally with such individuals. Males provided with female wings apparently suffer no disadvantage in mating with females. These and other similar observations lead the author to conclude that the sexes pay no attention to the appearances of their partners, and that the dark coloration of the male has not been brought about through sexual selection on the part of the female.

P.

A New Text-Book on Echinoderms.[1] — It is difficult to characterize this part of *A Treatise on Zoölogy*, edited by Professor E. Ray Lankester. What it contains has already been presented to students in a far better form and free from the insular prejudices which are apparent throughout the work. One might almost imagine from the preface that there was a British natural history of echinoderms, as contrasted with that found in the text-books of Zittel, Claus, Neumayer, Hertwig, Korschelt, Heider, and many others which will naturally suggest themselves to the student of echinoderms.

The great value of a text-book consists in an impartial presentation of well-ascertained facts and not in spreading before the reader the peculiar views held by the authors, especially when they are mere speculations reminding us of the elaborate disquisitions of Haeckel on the imaginary crinoids he so carefully figures and describes in his last memoir on the subject.

It would be difficult to write a general description of the echinoderms more likely to confuse the students than the one given by Mr. Bather in the introductory chapter to this part of Lankester's *Treatise on Zoölogy*. It is noted for dwelling on what is not known and for giving us as little as possible (for a work of such pretension) on the structure and embryology of the groups.

The speculations of Mr. Bather might make an article in a geological magazine, but have no place in a text-book designed for "senior students of zoölogy." With the mass of material available to illus-

[1] *A Treatise on Zoölogy*, edited by E. Ray Lankester; Pt. iii, The Echinoderma, by F. A. Bather, assisted by J. W. Gregory and E. S. Goodrich. London, 1900. Adam and Charles Black. 8vo, 344 pp., 11 figs.

trate the anatomy and embryology of echinoderms, it is hardly possible to have given less characteristic illustrations of their structure and development than those selected by Mr. Bather in his introductory chapter on the "Echinoderma."

Mr. Bather has a very extensive and accurate knowledge of the crinoids, and he has given an excellent account of the group, but it is entirely out of proportion to the very moderate one given of the holothurians, starfishes, and Echinoidea. One need only compare Zittel's account of the Echinoidea and Crinoidea with those of Mr. Bather and of Mr. Gregory to see how far Mr. Gregory's account of the Echinoidea falls short of Zittel's admirable presentation of the history of the order.

The authors unite the ophiurans with the starfishes; in this they certainly will not receive the assent of writers on echinoderms, nor is their association of the holothurians, starfishes, and Echinoidea as "Eleutherozoa" in contrast to the Pelmatozoa likely to be accepted.

The student of zoölogy is certainly entitled to a better account of the holothurians than that given by Mr. Goodrich. With the superb figures of Semper, Theel, Ludwig, Semon, and many others available, such figures as are given on pages 218, 219, 222, and 223 are hardly creditable in what is intended to be an important text-book.

The figures as a whole vary greatly in quality; many of the outline cuts of the crinoids and the analyses of the plates are coarse. The figures of the few fossil Echini given are poor, and a large number of the illustrations which accompany the starfishes and ophiurans are not even good as diagrammatic sketches.

The palæontology of the echinoderms is not to be compared with that of Zittel and of Neumayer, and the volume bears too plainly the mark of having been written by palæontologists and not by morphologists familiar at first hand with the structure and development of echinoderms.

Notes. — Students of earthworms will be interested in the results of Michaelsen's recent studies of Kinberg's types of Oligochæta (*Ofversigt k. Vet. Akad. Forhandl. Stockholm*, Bd. LVI, 1900). The only species from the United States included is *Pherctima californica*, which is shown to include two species of Amyntas, *A. californica* and *A. indica*.

In the Stockholm Academy's *Proceedings* (Vol. LVII, No. 1, p. 13) Dr. Einar Lönnberg gives an account of the observations of Professor von Grimm and himself on the fauna of the Caspian. Species of

Gobius, Benthrophilus, and Syngnalhus were obtained, together with numerous Crustacea, many Mollusca, a few worms, and some algæ.

A study of the genera Hygroceleuthus and Dolichopus has led Melander and Brues (*Biol. Bull.*, Vol. I, p. 123) to place all flies belonging to the former genus under Dolichopus, though the species thus transferred form a natural group of less than generic value. In their revision of this genus the authors describe thirteen new species.

The structures which have been described by previous writers as the rudimentary dental ridges in embryo birds have been reinvestigated by H. D. Tjeenk Willink (*Tijdschr. d. Ned. Dierk. Ver.* (2), Bd. VI (1900), pp. 243–254, Taf. XI). These structures are easily identifiable in many species of birds, but are too well developed to be called rudimentary. If they are the remains of dental ridges, which the author believes is by no means certain, they have most assuredly assumed secondary functions and contribute materially to the formation of the horny bill. This function in itself is a sufficient explanation of their presence, without assuming that they are the remains of dental ridges.

Vanhöffen (*Zool. Anzeiger*, Bd. XXIII (1900), pp. 277–279) has investigated the finer structure of three genera of deep-sea medusæ, Atolla, Periphylla, and Periphyllopsis, on material all of which was collected from a greater depth than 600 meters. Both Haeckel and Maas believed that the deep-sea medusæ possessed, in addition to statocysts, eyes of a simple type. Vanhöffen finds no evidence of eyes in the material studied by him and believes that Haeckel mistook pigmented entoderm for eyes, and that Maas was in error because of imperfectly preserved specimens.

Bittacomorpha clavipes Fabr., a near relative of the crane flies, is characterized by having enormously swollen metatarsi on all its legs. Brues (*Biol. Bull.*, Vol. I (1900), pp. 155–160) has found that an enlarged tracheal tube occupies almost the entire cavity of the swollen metatarsus. As this insect flies poorly, the author believes that the balloon-like enlargements of its metatarsi enable it to be wafted easily by currents of air. The coloration of these parts gives the animal, when suspended in air, a striking resemblance to drifting thistle seeds.

The third number of Vol. I of the *Biological Bulletin* contains the following papers: "The Early Cleavage and Formation of the Mesoderm of Serpulorbis squamigerus Carpenter," by S. J. Holmes; "New

Species of Hygroceleuthus and Dolichopus," with remarks on Hygroceleuthus by A. L. Melander and C. T. Brues; "On the Origin of the Sperm Blastophore of Some Aquatic Oligochæta," by S. Hatai; "Peculiar Tracheal Dilatations in Bittacomorpha clavipes Fabr.," by C. T. Brues; and "Lampreys in Captivity," by A. M. Reese.

BOTANY.

Alternation of Generations in Algæ.[1] — The author has made a careful study of the European forms of the Cutleriaceæ, a small but interesting group of algæ, and the results are given in this paper of one hundred pages. Two genera have been known in European waters, Zanardinia and Cutleria, the former represented by a single species, *Z. collaris*, the latter by two, *C. multifida* and *C. adspersa*. Each is represented by a sexual and an asexual form, in Zanardinia indistinguishable in habit, but in Cutleria so different that the asexual form was long known as a separate genus, Aglaozonia.

The paper begins with a thorough résumé of the previous investigations by Thuret, Reinke, Falkenberg, Janczewski, Kuckuck, and Church, which showed Aglaozonia to be included in the Cutleria cycle of development, assigning to *C. multifida*, *A. parvula*, and to *C. adspersa*, *A. chilosa*. The author has discovered a new form, *A. melanoidea*, occurring in the Mediterranean and on the Atlantic coast of Morocco, thus giving three sexual to two asexual forms. Though absolute proof has not been obtained, the author seems justified in regarding the new form as connected with *C. adspersa*, the sexual form corresponding to *A. chilosa* being yet to be discovered. As the asexual form of *C. multifida* has a farther range northward than the sexual form, it is not improbable that the sexual form of *A. chilosa* may be some little known tropical or subtropical species.

In studying the fertilization and development of Cutleria we find a curious complexity. The sexual form is diœcious; in many localities only the female plant is known, propagating freely by parthenogenesis; in some localities male plants are extremely rare; in others they occur in equal numbers with the female, or are even twice as common; but in only one place have cultures shown fecundation of the oöspore. In the locality where the male plant is most abundant

[1] Sauvageau, Camille. Les Cutlériacées et leur alternance de Générations, *Ann. Sci. Nat.*, Ser. 8, Botany, vol. x, pp. 265–362.

no trace of fertilization, or even of attraction between the anthero-zoids and spores, was found, but parthenogenetic growths were abundant. These growths were of two distinct types, both of which were found, only more fully developed, in plants growing in the sea, the two forms there growing intermingled, though not so in cultures. These forms the author designates, from their respective discoverers, as "forme thuretienne" and "forme falkenbergienne," the former producing first a "support," the summit of which is then transformed into a Cutleria frond, the latter a stout cellular cylinder, here called "colonnette," from the base of which grows out an Aglaozonia frond. It would seem that either of these forms may be produced by either Aglaozonia or Cutleria spores, in the latter case by either fertilized or unfertilized spores, so that, instead of a definite alternation of generations, as in ferns and mosses, either the sexual or the asexual form may reproduce itself for an indefinite number of generations, changing to the other under conditions unknown to us.

The "colonnette" is a peculiar development; the author regards it as an atavistic proembryo, representing what was a normal state in the remote history of the type, but is now only a survival, of no use to the individual. These three forms now found in the same species give the latter a wide range of affinities among the brown algæ, indicated by the author as follows: Cutleria, thallus with Ectocarpus, Tilopteris, Carpomitra; reproduction with Tilopteris, Sphacelaria. "Colonnette," thallus with Myriotrichia, Litosiphon; reproduction unknown. Aglaozonia, thallus with Battersia, Sphacelaria, Zonaria, Padina, Dictyota; reproduction with Zonaria, Laminaria. It is this wide range of affinities that makes the study of this little group of so much interest.

The paper is abundantly illustrated from excellent drawings by the author.

F. S. Collins.

Micro-Organisms and Fermentation.[1] — The translation of the third edition of Dr. Jörgensen's well-known work on the subject, in which his word is one of authority, is doubtless a good service for many English-speaking readers. The general subject of fermentation is here so construed as to exclude decomposition changes; the chief phases treated dealing with those activities producing characteristically acetic, lactic, and butyric acids, slime, and alcohol. The

[1] Jörgensen, A. *Micro-Organisms and Fermentation.* Third edition, translated by Alex. K. Miller and A. E. Tennholm. London, Macmillan & Co., 1900. 318 pp., 83 figs.

organisms producing these changes, bacteria, mould fungi, and yeasts, are discussed, chiefly from the standpoint of their morphology and physiology. The most important alcohol-producing organisms are treated in some detail. Here, as throughout the book, the work of Hansen is cited at great length.

Since the work is intended for the brewer and the distiller as well as for the student of the purely scientific side of the subject, much of brewery and distillery technique finds place. As the standpoint of the author is decidedly that of the morphologist, the chemical side of fermentation is disposed of in the briefest manner. On the whole, the book gives a very useful account of the subject as seen from the standpoint of an enthusiastic disciple of Hansen. A fairly complete bibliography of the subject unfortunately closes the book. It is difficult to explain why a work of this scope, intended for frequent reference, should utterly lack an index, but such is the case.

Notes. — Professor Rowlee begins the publication of a series of notes on North American willows in the May number of the *Bulletin of the Torrey Club*, the first part dealing with the Longifoliæ, of which twelve species are recognized, three of them, as well as several varieties, being considered new to science. Gratification is expressed at the necessity that has been found of restoring all of Nuttall's species.

The taxonomic value of the staminate flowers of some species of Quercus is shown by Professor Rowlee and Miss Nichols in the *Botanical Gazette* for May.

The Lycopodiaceæ of the United States are found in review by Lloyd and Underwood in the *Bulletin of the Torrey Club* for April.

Dr. Spegazzini, in the March number of the *Anales de la Sociedad Científica Argentina*, gives some interesting notes on the irritability of the stamens of certain cacti, the extra floral nectar glands of *Opuntia monacantha*, and the narcotic properties of the floral nectar of *Echinocactus gibbosus*.

Professor Nelson's active study of the Wyoming flora leads to the revision of the cormose-rooted Rocky Mountain claytonias in the *Bulletin of the Torrey Botanical Club* for May, in which he further publishes a considerable number of new species of various groups.

In No. 5 of the *Contributions from the New York Botanical Garden* Dr. Rydberg begins a series of studies on the Rocky Mountain flora, the first number of which deals with certain groups of Senecio.

An annotated catalogue of the ferns and flowering plants of Oklahoma, by Professor Bogue, constitutes *Bulletin No. 45* of the Oklahoma Agricultural Experiment Station.

An interesting series of plant-formation figures is being published in the current numbers of the *Revue Générale de Botanique*, in illustration of a paper by Boergesen and Paulsen on the vegetation of the Danish West Indies.

The flora of the Azores, which was summarized in the *Eighth Report of the Missouri Botanical Garden*, receives several important additions in a paper by Gandoger, published in the *Bulletin de la Société Botanique de France* for February.

PALÆONTOLOGY.

Zittel's Text-Book.[1] — The appearance of von Zittel's *Grundzüge der Palaeontologie* in 1895 was generally welcomed as being a most convenient and well-executed outline of the elements of the science. No English translation of any similar foreign book on the general subject had heretofore been published, and the excellence of this work and the fame of its distinguished author seemed to demand its reproduction into English.

Dr. Charles R. Eastman undertook the translation and editing. As a former pupil of Professor von Zittel, and a palæontologist himself, he was especially well qualified for this task. After consultation with a number of leading educators, and with the consent of the author, it was decided to submit different portions to specialists for independent revision. The plan of the original work has been followed throughout, though the amount of revision really makes it a distinct publication.

The early chapters on the Protozoa and Cœlenterata received very little alteration and stand essentially as in the original. The list of collaborators and the subjects revised by them are as follows: Wachsmuth, the Crinoidea and Blastoidea; Sladen, Asteroidea and Echinozoa; Hinde, Vermes; Ulrich, Bryozoa and Ostracoda; Schuchert, Brachiopoda; Dall, Pelecypoda; Pilsbry, Gastropoda; Hyatt, Cephalopoda; Beecher, Trilobita; Clarke and Kingsley, the Eucrustacea

[1] Zittel, Karl A. von. *Text-Book of Palæontology.* Translated and edited by Charles R. Eastman. London, Macmillan & Co., 1900. Vol. i, x + 706 pp., 1476 woodcuts.

and Acerata; Scudder, the Insecta. A few chapters, notably those on the Molluscoidea, Mollusca, and Trilobita, are entirely rewritten.

Science text-books are proverbially behind the advances of the sciences they represent. In general this conservatism is not without compensation, since no single author of a comprehensive treatise can judge of the value of new discoveries or adopt innovations until they have stood the test of time and become incorporated into the standard body of scientific literature. Much of this danger has been obviated by the coöperation of men of recognized authority in special branches and by their restraint in following along prescribed lines.

The result of this coöperation, as in the present volume, is a composite work. Instead of a compilation from various authorities, each chapter bears its own authority, and as such the book will have a standing and usefulness among advanced students it would not otherwise attain.

C. E. B.

NEWS.

The entomological collections of the late Professor J. A. Lintner are to be given to Cornell University by his widow.

The French Association for the Advancement of Science meets at Paris, August 2 to 9.

The International Botanical Congress will meet in Paris, October 1 to 10. The International Geological Congress meets at the same place August 16 to 28.

Fellowships for the college year 1900 to 1901 have been awarded as follows:

Johns Hopkins University: Lawrence Edmonds Griffin (Ph.B., Hamlin University), Adam Bruce fellow in biology.

University of Pennsylvania: J. R. Nurlin and Miss R. A. Vivian, zoölogy; Miss C. B. Thompson, biology.

Tufts College: R. J. Seymour (B.S., Ohio State University), biology.

Harvard University: W. A. Willard, zoölogy.

Appointments: Miss Cora J. Beckwith, of Ann Arbor, assistant instructor in zoölogy at Vassar College. — W. Bergt, professor extraordinarius of geology in the Dresden Technical School. — Dr. A. N. Berlese, of Bologna, assistant professor of botany in the University of Sassari, Sardinia. — Dr. W. Busse, docent for bacteriology in the University of Berlin. — F. Cavara, professor of botany and director of the botanical gardens at Cagliari, Sardinia. — Mr. Cecil B. Crampton, of Manchester, assistant geologist on the Scottish Geological Survey. — Dr. C. Eckstein, professor of zoölogy in the Forestry School at Eberswald, Germany. — Dr. A. Fritsch, of Vienna, professor extraordinarius of botany at the University of Gratz. — Dr. Ernst Göppert, professor extraordinarius of anatomy in the University of Heidelberg. — Dr. L. E. Griffin, instructor in biology in the Women's College of the Western Reserve University. — Dr. Georg Gürich, professor of geology and mineralogy at Breslau. — W. L. Jepson, assistant professor of botany in the University of California. — Hermann J. Kolbe, director of the zoölogical collection at Berlin, titular

professor. — Dr. Küster, of Munich, docent for botany in the University of Halle. — Dr. J. Marquart, of Tübingen, assistant in the Leiden Ethnographical Museum. — Dr. O. Mattivolo, of Florence, professor of botany in the University of Turin. — Dr. Max Meyer, of Worcester, professor of psychology in the University of Missouri. — Dr. V. Schmidt, of Dorpat, privat docent for histology and embryology at the University of St. Petersburg. — Dr. Schmeisser, of Clausthal, director of the Geological Institute of the School of Mines in Berlin. — James M. Tuomney, of Arizona, assistant professor of forestry at Yale University.

Deaths : Adrien Franchet, botanist, in Paris, aged 66. — Dr. O. Hoffmann, lepidopterologist, at Regensburg, February 22, aged 64. — Dr. H. Kiärskow, editor of the *Botanisk Tidsskrift*, Copenhagen, March 18, aged 64. — Miss Mary H. Kingsley, the well-known African explorer, at Simon's Bay, South Africa, in June. — Dr. E. J. Lowe, a British naturalist, at Chepstow, March 10. — Carl Meinshausen, of the botanical museum of the Academy of Sciences at St. Petersburg. — A. Pellerin, director of the botanical gardens at Nantes, France. — Mr. James Thompson, of Glasgow, a geologist, aged 77. — Professor W. Waagen, professor of palæontology in the University of Vienna, and formerly of the Indian Geological Survey, in Vienna, March 24, aged 59. — Dr. Hugo Zukal, professor extraordinary of botany in the Agricultural School at Vienna, February 15, aged 55.

PUBLICATIONS RECEIVED.

(Regular exchanges are not included.)

BELZUNG, A. Anatomie et Physiologie Végétales. Paris, Félix Alcan, 1900. 8vo, iii + 1320 pp., 1700 figs. 20 francs.

Biological Lectures from the Marine Biological Laboratory of Woods Holl, 1899. Boston, Ginn & Company, 1900. 282 pp.

DANA, MRS. WILLIAM STAR. How to know the Wild Flowers. New edition with colored plates. New York, Scribners, 1900. 8vo, xxxix + 346 pp., 152 pls., some colored. $2.00.

HARTERT, ERNST. Das Tierreich. 9. Lieferung, Aves, Trochilidæ. Berlin, Friedländer, 1900. ix + 254 pp. 16 marks.

KEELER, HARRIET L. Our Native Trees and how to identify them. New York, Scribners, 1900. 8vo, xxiii + 533 pp., plates and woodcuts. $2.50.

WILLEY, ARTHUR. Zoölogical Results based on Material from New Britain, New Guinea, Loyalty Islands, etc. Part IV contains: Gardiner, J. S., On the Anatomy of a Supposed New Species of Cœnopsammia from Lifu; Sharp, D., On the Insects from New Britain; Borradaile, L. A., On the Stomatopoda and Macuna; Collinge, W. E., Report on the Slugs; Phillips, E. G., Report on the Polyzoa; Thornley, L. R., The Hydroid Zoöphytes; Lister, J. J., Astrosclera willey, and the Type of a New Family of Sponges; Pycroft, W. P., A Contribution toward our Knowledge of the Pterylography of the Megapodii; Hickson, E. J., The Stolonifera and Alcymacea; Ashworth, J. H., Report on the Xeniidæ. Cambridge, University Press, 1900. viii, 357–530 pp., Pls. XXXIV–LIII. 21/.

ASHMEAD, W. H. On the Genera of the Chalcid Flies belonging to the Subfamily Encyrtinæ. *Proc. U. S. Nat. Mus.* Vol. xxii, pp. 323–414. — MILLER, W. S. (editor). The Anatomy of *Necturus maculatus*, etc. Contributions from the Anatomical Laboratory of the University of Wisconsin. *Bulletin of the University of Wisconsin, No. 33.* Science Series. Vol. ii, No. 3, pp. 144–146, Pls. III–XV. — WASHBURN, F. L. Notes on the Spawning Habits of the Razor Clam. Report by state biologist of Oregon. 6 pp., 2 pls.

Insect World. Vol. iv, No. 5. May. Gifu, Japan. — *International Monthly.* June. — *New York Zoölogical Society, Fourth Annual Report.* — *Proceedings Biological Society of Washington.* Vol. xiii, pp. 151–158. Merriam, C. H., Descriptions of Two New Mammals from California; Stephens, F., Descriptions of Two New Mammals from Southern California. — *West Virginia Agricultural Experiment Station, Bulletin Nos. 63–65.* Contains: Stewart, J. H., and Hite, B. H., Commercial Fertilizers, pp. 115–152 and pp. 179–196; Sugar-Beet Investigation in 1899, pp. 153–178.

(No. 403 was mailed July 25.)